

PCT

NOTIFICATION OF ELECTION
(PCT Rule 61.2)To:
Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

Date of mailing: 13 July 2000 (13.07.00)	in its capacity as elected Office
International application No.: PCT/GB99/04446	Applicant's or agent's file reference: PAT 98032p*P
International filing date: 24 December 1999 (24.12.99)	Priority date: 31 December 1998 (31.12.98)
Applicant: ATKINSON, Christopher et al	

1. The designated Office is hereby notified of its election made:

 in the demand filed with the International preliminary Examining Authority on:

01 May 2000 (01.05.00)

 in a notice effecting later election filed with the International Bureau on:

2. The election was was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer: J. Zahra Telephone No.: (41-22) 338.83.38
---	---

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
NOKIA IPR DEPARTMENT
 Nokia House
 Attn. HIBBERT, Juliet
 Summit Avenue
 Farnborough
 Hampshire GU14 0NG
 UNITED KINGDOM

<input checked="" type="checkbox"/> Corp Record <input checked="" type="checkbox"/> File Record <input checked="" type="checkbox"/> Diary <input type="checkbox"/> Renewal Record <input checked="" type="checkbox"/> Citations <input type="checkbox"/> Inv Award	
<i>19 MAY 2000 PCM</i>	
<input type="checkbox"/> Letters <input type="checkbox"/> CC	

PCT

AH
PSH
**NOTIFICATION OF TRANSMITTAL OF
 THE INTERNATIONAL SEARCH REPORT
 OR THE DECLARATION**

(PCT Rule 44.1)

Date of mailing
 (day/month/year)

16/05/2000

Applicant's or agent's file reference

PAT 98032p*P

FOR FURTHER ACTION

See paragraphs 1 and 4 below

International application No.

PCT/GB 99/ 04446

International filing date

(day/month/year)
24/12/1999

Applicant

NOKIA MOBILE PHONES LIMITED et al.

1. The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
 34, chemin des Colombettes
 1211 Geneva 20, Switzerland
 Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after 18 months from the priority date, the international application will be published by the International Bureau.

If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority
 European Patent Office, P.B. 5818 Patentlaan 2
 NL-2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3016

Authorized officer

Liliane Van Velzen-Peron

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the International application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When? Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been filed, see below.

How? Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the International application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the International application is English, the letter must be in English; if the language of the International application is French, the letter must be in French.

NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the International application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the International application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference PAT 98032p*P	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 99/ 04446	International filing date (day/month/year) 24/12/1999	(Earliest) Priority Date (day/month/year) 31/12/1998
Applicant NOKIA MOBILE PHONES LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :

contained in the international application in written form.

filed together with the international application in computer readable form.

furnished subsequently to this Authority in written form.

furnished subsequently to this Authority in computer readable form.

the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. Certain claims were found unsearchable (See Box I).

3. Unity of Invention is lacking (see Box II).

4. With regard to the title,

the text is approved as submitted by the applicant.

the text has been established by this Authority to read as follows:
BACKLIGHT FOR A PORTABLE DEVICE

5. With regard to the abstract,

the text is approved as submitted by the applicant.

the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

as suggested by the applicant.

because the applicant failed to suggest a figure.

because this figure better characterizes the invention.

8

None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

GB 99/04446

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 H04M1/22 H04M1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC 7 H04M G09G G02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 92 09163 A (UNIVERSAL CELLULAR INC) 29 May 1992 (1992-05-29) abstract page 5, line 8 -page 5, line 29 figures 1,4	1,2,4, 10-21
Y	---	3,5-9
X	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 09, 31 July 1998 (1998-07-31) & JP 10 096890 A (CASIO COMPUT CO LTD), 14 April 1998 (1998-04-14) abstract ---	1-3,16, 20
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

8 May 2000

Date of mailing of the international search report

16/05/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Golzio, D

INTERNATIONAL SEARCH REPORT

International Application No

GB 99/04446

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 03, 29 March 1996 (1996-03-29) & JP 07 294877 A (CASIO COMPUT CO LTD), 10 November 1995 (1995-11-10) abstract ---	3,5,6
Y	PATENT ABSTRACTS OF JAPAN vol. 009, no. 150 (E-324), 25 June 1985 (1985-06-25) & JP 60 031393 A (NIPPON DENKI KK), 18 February 1985 (1985-02-18) abstract ---	7-9
X	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 08, 30 June 1998 (1998-06-30) & JP 10 084408 A (NIPPON DENKI IDO TSUSHIN KK), 31 March 1998 (1998-03-31) abstract ---	1,16
X	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 01, 30 January 1998 (1998-01-30) & JP 09 230827 A (OKI ELECTRIC IND CO LTD), 5 September 1997 (1997-09-05) abstract ---	1,16
A	EP 0 861 017 A (NANAO CORP) 26 August 1998 (1998-08-26) abstract column 3, line 35 -column 4, line 13 figures 1-3 -----	20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

GB 99/04446

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 9209163	A 29-05-1992	AU 9100091	A	11-06-1992
JP 10096890	A 14-04-1998	NONE		
JP 07294877	A 10-11-1995	NONE		
JP 60031393	A 18-02-1985	NONE		
JP 10084408	A 31-03-1998	NONE		
JP 09230827	A 05-09-1997	NONE		
EP 0861017	A 26-08-1998	JP 10222129	A	21-08-1998
		JP 10222084	A	21-08-1998



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

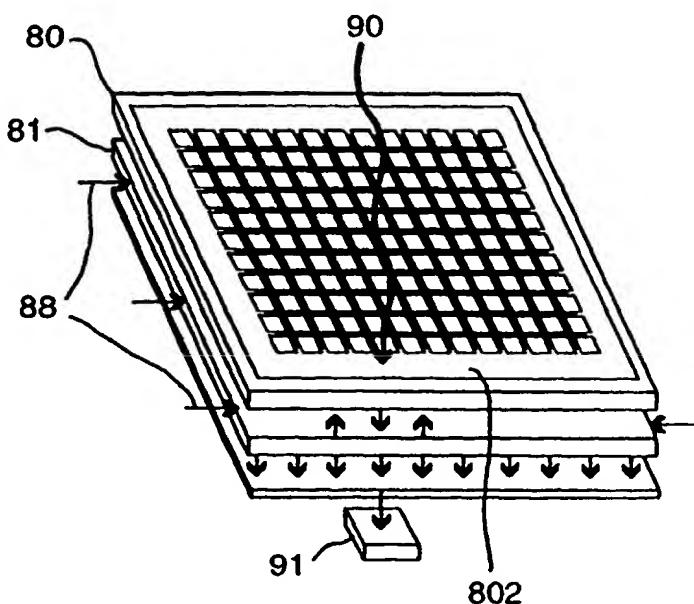
(51) International Patent Classification ⁷ : H04M 1/22, 1/02	A1	(11) International Publication Number: WO 00/41378
		(43) International Publication Date: 13 July 2000 (13.07.00)

(21) International Application Number: PCT/GB99/04446	(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
(22) International Filing Date: 24 December 1999 (24.12.99)	
(30) Priority Data: 9828878.0 31 December 1998 (31.12.98) GB 9913540.2 10 June 1999 (10.06.99) GB	
(71) Applicant (for all designated States except US): NOKIA MOBILE PHONES LIMITED [FI/FI] ; Keilalahdentie 4, FIN-02150 Espoo (FI).	
(72) Inventors; and	
(75) Inventors/Applicants (for US only): ATKINSON, Christopher [GB/GB] ; 8 Southwood Road, Dunstable, Beds LU5 4EA (GB). LEWIS, Ian [GB/GB] ; 7 Spencer Close, Church Crookham, Fleet, Hampshire GU13 0EG (GB). CAMERON, Ian [GB/GB] ; 15 Longbridge Road, Bramley, Tadley, Hants RG7 5AN (GB).	
(74) Agents: HIBBERT, Juliet et al. ; Nokia IPR Dept., Nokia House, Summit Avenue, Farnborough, Hants GU14 0NG (GB).	

(54) Title: BACKLIGHT FOR A PORTABLE DEVICE
--

(57) Abstract

A handportable device is disclosed which comprises a user interface (1), a light detector (21) for detecting the light incident on at least part of the user interface, a comparator for comparing the light detected with a given threshold and control means for controlling an illuminator for illuminating the user interface in dependence upon the output of the comparator. Preferably the light detector is positioned to detect light incident on the device, which light is the sum of ambient light and the light from the illuminator.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

BACKLIGHT FOR A PORTABLE DEVICE

5 The present invention relates to hand held devices such as radiotelephones, and in particular to the illumination and operability of the user interface of such devices.

10 Hand held devices such as radiotelephones conventionally have their user interface (e.g. display and keys) illuminated, to enable their use in the dark. However, backlighting of such input and output devices causes a drain on the battery of the device. Devices are known which conserve battery power by only illuminating the display and keypad lights for a predetermined period (e.g. 15 seconds) after a key press or incoming call.

15 According to the present invention, there is provided a portable device comprising: a user interface; a light detector for detecting the light incident on at least part of the user interface; a comparator for comparing the light detected with a given threshold; and control means for controlling an 20 illuminator for illuminating the user interface in dependence upon the output of the comparator.

25 Thus the invention provides both control of a user interface (e.g. a display and keyboard) backlighting to save power when the ambient light level is high and to control the backlighting brightness when the ambient light level is low. This is particularly important in mobile telephones that have web browsing and game capabilities where the display may be being viewed for long periods.

30 The photosensor preferably feeds an amplifier whose output controls the drive level of the illuminator and whose gain can be controlled to vary the light sensitivity threshold. Preferably the photosensor is placed under the border

area of a display where it receives not only ambient light but also some light scattered by the diffuser used to distribute light from the illuminator evenly across the display. This location of the sensor gives the following benefits:-

5 1. The sensor in this location is least likely to be obscured by a user, being in an area viewed by the user. As devices such as phones get smaller, other locations are likely to suffer from light being obscured by the user's hand with consequential annoying illumination level fluctuations and reduced operating times.

10

2. Backlighting is primarily needed for display illumination therefore positioning the photosensor under the display is the prime location where ambient light received by the sensor represents the true ambient light level illuminating the display. This prevents shadows and uneven lighting from fooling the light detector as the backlight level will only respond to changes in ambient light actually entering the display.

15

3. Integration of backlight brightness control into the light sensitivity control giving the user a single up/down illumination level is possible if the sensor is positioned such that it receives a light level that represents the total light contributing to display illumination which is the sum of both backlight and ambient light. The best location where this is possible is behind the display.

20

This scheme obviates the need for two user controls, one for backlight brightness and another for light sensitivity threshold, which would require more complex software and hardware to control.

25

The invention saves battery power by reducing display backlighting brightness when ambient light level is high and also provides user control backlighting intensity when ambient light level is low. This is particularly important in mobile telephones that have web browsing and game capabilities where the display may be being viewed for long periods.

Sensing light via the display allows the ambient light control to seamlessly control the backlight brightness in low ambient light conditions by simply increasing the sensitivity level to detect the light scattered from the backlight
5 diffuser. For example, a user equipped with a phone with separate brightness control may try to adjust the brightness but if the ambient light level is high the ambient light detection will turn off the backlight so the user will have a feature which appears to do nothing. However, light sensing through the display senses the total illumination light level rather than just ambient light.

10

The invention also relates to a method of calibrating the sensitivity levels of a light detector. Having the light detector located to receive both the ambient light and the light from the illuminator means that the illuminator can be used to calibrate the light detector. This obviates the need for an external light
15 source for calibration purposes.

If an external light source were to be used instead, the source would need to be switchable but such light sources may require time to stabilise (e.g. 30 seconds which is too long for production techniques). This is not the case
20 with the illuminators used with portable devices such as mobile telephones.

The light detector is advantageous as it provides efficient power conservation due to its detection of actual light, whether it be day light or artificial light.

25 The control means may turn the user interface illuminator off, for example, if the light exceeds a threshold. That is the illuminator is turned off when there is sufficient light for a user to see the user interface, and on when there is insufficient light. Preferably, the device also compares the light detected with a second lower threshold. In such an embodiment, the illuminator is off if the
30 light detected is above the first threshold, on if it is below the second threshold, and variable if it is between the two. Examples of variable

illumination include only back lighting one or other of a user input and user output of the user interface (for example a keyboard and display), or by varying the intensity of the illumination.

5 Furthermore, the output of the light detector may be compared over a predetermined period (e.g. 30 seconds) to determine whether any change in intensity is found. A determination of no such change can be used as an indication that the device is not currently being used; for example it may be in a pocket, brief case or remote from the user etc. In this event, the illuminator
10 and/or user interface may be suspended.

The device may operate in different modes, depending on the desired profile. Profiles may include outdoor, meeting, office etc. Consequently, such a device may take into account artificial light conditions, and thus improve
15 power conservation. For example, the backlighting default for the meeting and office profiles may be off.

Selection of the desired profile may be altered manually by the user, or if the device has a calendar, it could be linked to the calendar's contents.

20 Further, the device is arranged so that the user can personalise the backlighting settings via the user interface.

Embodiments of the present invention will now be described, by way of
25 example, with reference to the accompanying drawings, of which:

Figure 1 is an exploded view of a radio telephone which may implement the present invention;

Figure 2 is a block diagram of a device whose operation depends on light detection according to an embodiment of the present invention;

30 Figure 3 shows light detection circuitry according to an embodiment of the present invention;

Figures 4a to 4c show examples of light detectors which could be incorporated in device of the present invention;

Figure 5 illustrates light detection circuitry according to a preferred embodiment of the present invention;

5 Figures 6a and 6b illustrate methods of operation of a device depending upon light detection;

Figure 7 shows an exploded view of a display module according to the invention;

Figure 8 shows a perspective view of the arrangement shown in Figure 7; and

10 Figure 9 shows the typical forward current-forward voltage characteristics of a phototransistor; and

Figure 10 illustrates light detection circuitry according to a further embodiment of the present invention.

15 Figure 1 is an exploded view of a substantial part of a radio telephone 10, comprising a main body 11, front cover 12, and keymat 13. The keymat 13 comprises an array of depressible keys 16 and may, for example, be made from a single piece of silicon rubber. The upper surfaces of the keys include an indicia region which is marked so as to bear an indicia serving to indicate
20 the functionality of the keys, e.g. alphanumeric character or other symbol. The main body 11 comprises a circuit board having an array of electrical contact regions (not shown) corresponding to the keys 16. A contact membrane provides an array of domed contact elements 17 made from metal. Each contact element is arranged to lie intermediate to key 16 and its
25 corresponding electrical contact region. Each key 16 has a projection depending centrally from its rear and when a key is depressed this projection causes the corresponding domed contact element 17 to snap from a first natural bias position in which electrical connection is not effected to a second distorted position in which the contact element causes an electrical
30 connection to be made.

The circuit board also comprises light emitting diodes (LEDs) 18 for backlighting the keys. The membrane has holes corresponding in position to the LEDs, and the silicon rubber keymat is preferably translucent. Further, it is preferable for the rear of the keymat 16 to be moulded to provide a light 5 guide from an LED 18 to a surrounding group of keys 16, so as to provide even backlighting.

The main body 11 also comprises a liquid crystal display (LCD) module 14. A row of LEDs 15 is provided on each side of this display so as to illuminate it.

10

The LCDs 15, 18 may be connected to the same or different control circuitry depending upon device requirements. Likewise, the keymat LCDs 18 may be controlled individually, as a group, or all together.

15 A method of controlling the LCDs using a transducer in accordance with an embodiment of the invention will now be described with reference to Figure 2.

The device of Figure 2 comprises transducers in the form of a light detector 21. The device also comprises control means 23, and a user interface 24, 20 having an input 25 and output 26. The input may, for example, be a keypad as in Figure 1, or alternatively a touch screen, voice detector or the like. The output may, for example, be a display as in Figure 1, or alternatively a loudspeaker or the like.

25 The control means 23 controls functionality relating to the user interface, depending upon the output of the light detector 21 as follows.

The light detector 21 detects the level of light surrounding the device, converts it into a corresponding electrical signal and forwards it to the control means 30 23. The control means 23 stores the threshold level at which backlighting should be switched on/off and compares the detected light signal with this threshold. A detected light signal above the threshold is an indication of

sufficient natural/artificial daylight and thus the backlighting is switched off. On the other hand, a detected light signal below the threshold is an indication of darkness, and consequently, the control means 23 turns the input and output backlighting on. In this event, the control means may switch the 5 backlighting permanently on. Alternatively, it may be arranged so as to only turn the backlighting on in certain circumstances, such as in response to an input by the user (e.g. key depression) or an incoming call.

10 If the control means 23 determines that the surroundings are dark, it preferably also samples the detected light signal over a predetermined period. If no variation is detected, it is assumed that the device is in a pocket, brief case etc. In this event, the control means 23 turns the backlighting and the output 26 off.

15 The light detector 21 is discussed in more detail below with reference to Figures 3 to 5. However, it may be positioned in a device for example anywhere in which it can detect external light and the light scattered by at least some of the LEDs 16, 18. In a radiotelephone, for example, it may be provided in the vicinity of the display backlighting LEDs.

20

Figure 3 illustrates a schematic diagram of the operation of key and display backlighting according to an embodiment of the present invention.

25 It is a series circuit comprising a battery, illuminator 33 and two switches, referenced 32 and 34. Switch 32 is operated under control of a control means on the basis of the output of a light detector 31, and switch 34 is operated depending on other circumstances, 35, namely when a key is depressed or call received. Only when both switches are closed will the illuminator 33 turn on.

30

Control means 36 closes switch 32 if the light sensor 31 detects insufficient light.

Switch 34 is closed in response to an input, such as when a key is depressed or a call is received. Preferably, this switch 34 is closed for a predetermined period (e.g. 15 seconds) after the input and then reopens.

5

Consequently, only when the device is in sufficiently dark surroundings and an input is received will the illuminator 33 illuminate. As a result, power is conserved, resulting in an increase in operational time of the device.

10 The light detection part of this circuit operates according to Figure 6b. That is, the control means 36 compares the light detected by the light sensor 31 with a threshold L_{TH1} . If the light detected is above this threshold the switch is open and backlighting is off, whereas if it is below the threshold, the switch is closed and the backlighting is on (when switch 34 is closed). However, the
15 light sensor 31 and switch 32 may be replaced by variable sensor, and the control means 36 arranged to operate according to the illustration of Figure 6a. In this case, the control means 36 stores two threshold values, one indicative of minimum sufficient daylight, L_{TH1} , and one indicative of minimum night light, L_{TH2} . If there is sufficient daylight the backlighting is off, if it is dark
20 the backlighting is on (assuming switch 34 is closed) and if the light detected is between the two (for example dusk) then the backlight is partially illuminated (again assuming switch 34 is closed). Partial illumination may mean illumination of the display and not the keypad, or it may mean only some of the LED's of the backlighting are illuminated. However, preferably it
25 means that the intensity of the backlighting is inversely proportional to the light level detected i.e. it increases in intensity from the lowest threshold when it reaches L_{TH1} to maximum illumination when it reaches L_{TH2} .

30 Figure 4 illustrates typical light sensors which may be used in the device of the present invention. Figure 4a illustrates a photo resistor, and Figures 4b and 4c illustrate photodiode arrangements.

Figure 5 illustrates in more detail light detection circuitry according to an embodiment of the present invention. Operation of this circuit depends on the signal input to two inputs, a backlighting enable input 51 and a dimmer enable input 52. These inputs may be set by the user, for example by way of a menu 5 option of the device. The circuitry provides an integrated light detection and backlight control means, and operates as follows. If the backlight input 51 receives a backlight disable signal (low), transistor Q3 switches. Transistor Q2 is biased so that in this event it too is switched off and, consequently, backlighting LEDs D1 to Dn are off. The signal applied to the dimmer input is 10 irrelevant in this instance.

In contrast, if the backlighting input 51 receives a backlighting enabled signal (high), transistor Q3 is turned on, which in turn results in transistor Q2 turning on. Consequently, the backlighting LEDs D1 to Dn obtain the necessary 15 current to turn on. The intensity of these LEDs is determined by the signal applied to the dimmer input 52. If the signal is a dimmer disable signal, current is not drained from the collector of transistor Q2 and therefore the backlighting LEDs D1 to Dn illuminate at maximum intensity.

20 When the dimmer is enabled, on the other hand, transistor Q4 is switched on and the amount of current drained from the collector of transistor Q2 depends upon the level of light detected by the photodiode PD. The less light detected the less current the photodiode draws, resulting in more illumination by the backlighting LEDs D1 to Dn.

25 The dimmer input may be varied in response to a user input (e.g. a user selecting the amount of illumination) or in response to a profile selected by a user or in response to the light detected by the light detector.

30 Figure 7 shows an exploded view of a display module in accordance with the invention for use with a device. The display module comprises a LCD panel 80, a diffuser in the form of a lightguide 81, a reflector 82, a mount 83 and

PCB connectors 84 and 85. Information is displayed on the LCD panel 80. The lightguide 31 diffuses the light emitted by the LEDs 15 which are positioned within apertures 86 of the mount 83. Apertures 89 provide a light path from the LEDs to the lightguide 81. The mount 83 is also provided with 5 apertures 87 for the location of at least one phototransistor.

Figure 8 shows a perspective view of the display arrangement shown in Figure 7. The phototransistor 91 is placed under the border area 802 of the display where it receives not only ambient light but also some light from the 10 LEDs 15 which enters the diffuser 81 by means of apertures 88. In this position the phototransistor is least likely to be obscured by a user when the device is in use. The phototransistor therefore receives a light level that represents the total light contributing to display illumination which is the sum of both the backlight and the ambient light incident on the display. Arrow 90 15 indicates the light path to the sensor 91.

The photosensor 91 is located such that it receives approximately equal proportions of ambient light and backlight in relation to their contribution to display illumination, the total of which is therefore maintained at a constant 20 level as any deficit in ambient light below the preset amplifier threshold is compensated for by an increase in backlight drive levels. Therefore with no ambient light the amplifier threshold merely controls backlight intensity which is the key to the calibration method described below as the backlight as a visible and easily measurable indicator of the light detector sensitivity. The 25 backlight brightness or corresponding drive level can be measured in one of three ways. 1) light meter or imaging system, 2) supply current measurement or 3) backlight drive voltage or current measured by appropriate hardware and software within the device.

30 The photosensor 91 feeds an amplifier that has a controllable threshold (as described above and below). The output of the amplifier is then used to control the backlight drive level in such a way that the backlight intensity is

reduced if the light level received by the sensor is above a pre-set threshold, of which there may be many selectable by a user. These thresholds require calibration owing to component tolerance variations and a method of carrying out the calibration is described below.

5

Figure 9 shows a further example of light detection circuitry in accordance with the invention. The light detection circuitry uses the voltage developed across a current sense resistor R_{sense} in series with the LED array 98 to turn on a transistor when this voltage equals the base-emitter junction voltage V_{be} .

10 This transistor is configured to divert base current from the LED drive transistor and hence limit the total backlight current to $I_{backlight} = V_{be}/R_{sense}$.

The light detector does not affect the constant current part of the LED drive except to back off the drive level to the base of the LED drive transistor when

15 the ambient light is high enough.

A discrete transistor comparator 94 compares a controllable reference voltage V_c with the voltage across a pull-up resistor R_p providing current for the phototransistor 96. This sets the current for the phototransistor 96 and hence

20 the light level threshold for detection with the higher reference voltages relating to lower phototransistor current and hence higher sensitivity to light. Lowering the sensitivity by reducing the control voltage V_c will therefore result

in a higher ambient light level threshold. The output of the comparator 94 drives the constant current LED circuit 98. The control voltage is generated

25 by an electronic circuit such as an analogue-to-digital converter which is arranged to generate a plurality (e.g. 32) approximately equal voltage steps between 0V and V_{bb} . An example of these is shown in the table below:

Step	Voltage	Step	Voltage	Step	Voltage	Step	Voltage
01	88.2 mV	09	795	17	1502	25	2209
02	176	10	883	18	1590	26	2297

03	265	11	971	19	1678	27	2386
04	353	12	1060	20	1767	28	2474
05	442	13	1149	21	1856	29	2563
06	530	14	1237	22	1944	30	2651
07	618	15	1325	23	2032	31	2740
08	707	16	1413	24	2121	32	2832

The design of the light detector circuit of Figure 9 is such that the control voltage V_c must exceed a voltage equal to the V_{be} of the transistor before it can operate. Steps 01 to 06 therefore have no effect and actually disable the 5 ambient light compensation which means that the backlight will be fully on. It is however recommended that the step 00 (0mV) be used for the purpose of disabling the ambient light detector 21 since any other value will prevent the device from entering the sleep mode. Preferably only control steps values above step 10 should be used as this gives sufficient voltage margin above 10 V_{be} to ensure satisfactory light detection, taking temperature fluctuations into account.

Typical forward current-forward voltage characteristics of a photodetector PD are shown in Figure 10 and, as can be seen, these are non-linear. A straight 15 line approximation would give unacceptable errors. Therefore a good approximation has been found by measuring/calibrating the LED array voltages V_{BLH} and V_{BLL} for the backlight (BL) at two extreme currents (I_{BLH} (maximum brightness) and I_{BLL} (minimum brightness)) and then assuming that the gradient changes linearly between these two points. The gradient 20 calculation based on the LED voltage would then be based on the gradient of a straight line. V_{BLL} (the LED voltage when the LED current produces minimum brightness) and V_{BLH} (the LED voltage when the LED current produces maximum brightness) are suitable calibration points. Therefore a straight line approximation for LED current I based on a LED voltage of V 25 would be:

$$I = I_{BLH} - \text{Grad}(V_{BLH} - V) \quad (1)$$

A more accurate approximation can be found by substituting a gradient calculation that gives a gradient that changes linearly with LED voltage between the steepest gradient (GRAD BLH) at the upper calibration point and 5 the gradient between the upper and lower calibration points, i.e. :

$$\text{Grad} = \text{Grad BLH}(1 - (V_{BLH} - V)/C) \quad (2)$$

where C is a gradient coefficient.

10

Combining equations 1 and 2 gives the following equation for the backlighting current:

$$I = I_{BLH} - ((V_{BLH} - V) * \text{Grad BLH} * (1 - (V_{BLH} - V)/C)) \quad (3)$$

15

The gradient coefficient can be derived from by re-arranging equation 3 and substituting the low calibration points V_{BLH} and I_{BLH} in place of V and I respectively i.e.:

20

$$C = \frac{\frac{V_{BLH} - V_{BLL}}{I_{BLH} - I_{BLL}}}{1 - \frac{\text{Grad}_{BLH}(V_{BLH} - V_{BLL})}{I_{BLH} - I_{BLL}}}$$

Calibration measures the maximum backlight drive level. This can be determined by measuring V_1 , V_2 (see Figure 9) or by using a light meter. Depending on the level and number of thresholds to be calibrated the detector 25 is enabled and the sensitivity adjusted until each of the required backlight levels are achieved. For example, to calibrate three ambient light threshold levels corresponding to 25%, 50% and 75% of maximum backlight level with a maximum backlight current of 100 mA using current measurement would involve increasing the sensitivity and noting the sensitivity when the backlight

current falls to 75mA, 50mA and 25mA respectively. When the user changes the ambient light settings the backlight brightness changes in steps approximately equal to 25% of maximum backlight brightness in darkness or up to the level determined by the background light level.

5

Calibration uses the backlight as the light source for calibration. This results in an ambient light calibration that is relative to the maximum light output of the light source. This has the advantage that in low ambient light situations, the illumination steps can be equal whereas, if an external light source were used, there may be a disproportionately large change in illumination between steps.

The following steps calibrate the output of the backlight and also the sensitivity control of the light detector:

- 15 1. Maximum current calibration
 - 1.1. Set the backlight control voltage to step 01 (i.e. light source OFF (but not in sleep mode))
 - 1.2. Phone current (i.e. between battery terminals) = Local Mode Current
 - 20 1.3. Turn light source full on (i.e. set control voltage to step 10)
 - 1.4. LED drive level (i.e. the voltage across the backlight LED array) = V_{BLH} . (The drive level is also used to calculate battery capacity)
 - 1.5. Phone current = Full on Current
 - 1.6. I_{BLH} = Full on Current - Local Mode Current

25 1.7. Fail if I_{BLH} is greater than 230mA or less than 150mA or if V_{BLH} is less than 846mV or greater than 1006mV.

2. Minimum current calibration
 - 2.1 Set the control voltage to step 1E (i.e. off)
 - 30 2.2 Read the LED drive level
 - 2.3 If LED drive level < 1.6 V, LEDs are off so decrement the control voltage and repeat steps 2.2 to 2.3

15

Else V_{BLL} = LED drive level

LEDs are now driven at minimum brightness

2.5 Measure phone current

2.6 I_{BLL} = Measured phone current - Local mode current

5 2.7 Fail if I_{BLL} is less than 65mA or if V_{BLL} is less than 2297mV

3 Backlight I-V gradient and High, Mid and Low settings

The backlight is calibrated to give three levels of illumination between full on

10 and off. These are indicated below as ADL_LIGHT (control value at lowest sensitivity (high illumination level)), ADL_MID (control value at mid point between ADL_LIGHT and ADL_DARK) and ADL_DARK.(control value at highest sensitivity (low illumination level)). These levels may be then be selected by a user either directly (e.g. from a menu) or by means of a profile 15 selection.

3.1 Let ADL_LIGHT= 12 (i.e. the LEDs are full on)

3.2 V_{BL} = LED drive level

3.3 If $V_{BL} > V_{BLH} + 0.8(V_{BLH} - V_{BLL})$ increment ALD_LIGHT and repeat steps

20 3.2 and 3.3

Else set $V_{BL}=V_{BL_LIGHT} \Rightarrow ALD_LIGHT$

ALD_LIGHT is the setting giving approximately 75% of maximum drive in dark conditions.

25 3.4 Measure phone current

3.5 I_{BL} = Measured phone current - Local mode current

3.6 Calculate I-V gradient $GradBLH = (I_{BLH} - I_{BL}) / (V_{BLH} - V_{BL})$

3.7 $ALD_MID = ALD_LIGHT$

30 3.8 Increment ALD_MID

3.9 V_{BL} = LED drive level

3.10 If $V_{BL} > V_{BLL} + 0.75(V_{BL_LIGHT} - V_{BLL})$ repeat steps 3.8 to 3.10

Else $V_{BL} = V_{BL-MID} \Rightarrow ALD_MID$

ALD_MID is the setting giving approximately 50% illumination relative to the maximum brightness.

- 5 3.11 ALD_DARK = ALD_MID
- 3.12 Increment ALD_DARK
- 3.13 $V_{BL} =$ LED drive level
- 3.14 If $V_{BL} > V_{BL_LIGHT} + 0.4(V_{BL_LIGHT} - V_{BL})$ repeat steps 3.12 to 3.14
 Else $V_{BL} = V_{BL-DARK} \Rightarrow ALD_DARK$
- 10 ALD_DARK is the setting giving approximately 25% illumination relative to the maximum brightness.

ALD_DARK, ALD_MID and ALD_LIGHT and GradBLH have now all been calibrated and are stored in the memory of the device for selection by a user or a profile.

15 In the preferred embodiment, the user can set the user interface to function in a desired manner for different operating environments. Typical profiles may include outdoor, meeting, silent and office environments. Backlighting options
20 for these profiles may be seen in Figure 11.

Figure 11a illustrates a profiles menu, and Figures 11b to e illustrate the options available within those profiles. In each case, option a is the default option. Take, for example, the interactive mode shown in Fig. 11b. The
25 default option is "automatic" i.e. the light detector for backlighting is on all the time. However, in the event that the user wishes to conserve power and yet still wishes to be able to see the user interface in the dark, he may choose to select option b, in which the backlight operates at half power. If the option is selected, the device sets the drive level for the backlight to the ALD_MID level
30 stored in the device. Alternatively, in order to provide an option whereby the option of being able to see the user interface is provided at the cost of power, option C is provided. Option D is an available option for each profile. If

selected, this option turns the backlight off completely. For example, the user may usually use the device for browsing the internet. The Interactive option may then be selected to set the backlighting to be determined by the light detector (option a). However if the user is in a dimly lit place (e.g. the 5 cinema), the user may wish to change the selection to option b so that the backlight is not turned on full when the device is used.

A further example of calibration will now be described with reference to Figure 9. This example calibrates for two ambient light settings at 1/3 and 2/3 of 10 maximum backlight level.

1. Turn BACKLIGHT ENABLE on
2. Set $V_c=0V$
3. Measure either V_1 , V_2 or backlight output
- 15 4. increase V_c until V_1 , V_2 or backlight output falls to 2/3 of measurement in 3. Record $V_c=$ Threshold 1
5. increase V_c further until V_1 , V_2 or backlight output falls to 1/3 of measurement in 3. Record $V_c=$ Threshold 2

20 The ambient light settings are selected by setting the V_c to the value recorded in 4 and 5 respectively. Setting V_c to step 01 turns the backlight on at a current determined by V_{be}/R_{sense} .

25 The present invention may be embodied in other specific forms without departing from its essential attributes. Accordingly reference should be made to the appended claims and other general statement's herein rather than to the foregoing specific description as indicating the scope of invention.

30 Furthermore, each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention independently of other disclosed and/or illustrated features. In this regard, the invention includes any novel features or combination of features disclosed

herein either explicitly or any generalisation thereof irrespective of whether or not it relates to the claimed invention or mitigates any or all of the problems addressed.

- 5 The appended abstract as filed herewith is included in the specification by reference.

Claims

1. A portable device comprising:
 - a user interface;
- 5 a light detector for detecting the light incident on at least part of the user interface;
 - a comparator for comparing the light detected with a given threshold;
 - and control means for controlling an illuminator for illuminating the user interface in dependence upon the output of the comparator.
- 10 2. A device as claimed in any preceding claim, wherein the light detector is positioned to detect light incident on the device, which light is the sum of ambient light and the light from the illuminator.
- 15 3. A device according to claim 2 wherein the user interface is a display.
4. A device as claimed in claim 1, 2 or 3 wherein the control means disables the user interface illuminator in response to an indication by the comparator that the light detected exceeds a first threshold.
- 20 5. A device as claimed in any preceding claim wherein the control means enables the user interface illuminator in response to an indication by the comparator that the light detected is less than a second threshold.
- 25 6. A device as claimed in claim 5, when dependent upon claim 4, wherein the control means partially enables the user interface illuminator in response to an indication by the comparator that the light detected is between the first and second thresholds.
- 30 7. A device as claimed in any preceding claim, further comprising means for determining a change in output of the light detector over a predetermined period, wherein the control means is arranged to disable functionality relating

20

to the user interface in response to an indication that no change is determined.

8. A device as claimed in claim 7, wherein the control means is arranged
5 to disable the user interface in response to an indication that no change is determined.

9. A device as claimed in claim 7 or 8, wherein the control means is arranged to disable the user interface illuminator in response to an indication
10 that no change is determined.

10. A device as claimed in any preceding claim, wherein the user interface comprises input means responsive to a user.

15 11. A device as claimed in claim 10, wherein the control means control the functionality relating to the user interface on the basis of settings input by the user via the input means.

12. A device as claimed in claim 10 or 11, wherein the input means
20 comprises touch means, such as a key and/or display region.

13. A device as claimed in any preceding claim, wherein the user interface comprises output means.

25 14 A device as claimed in claim 13, wherein the output means comprises a display.

15. A device as claimed in any preceding claim, which is a portable communications device such as a radiotelephone.

30 16. A method of controlling a handportable device including a user interface, the method comprising; detecting the light incident on at least part

of the user interface; comparing the light detected with a given threshold; and controlling illumination of the user interface in dependence upon the output of the comparator.

5

17. A portable device substantially as hereinbefore described with reference to and/or as illustrated in any one or any combination of the Figures of the accompanying drawings.

10 18. A method of controlling functionality of the user interface of a portable device substantially as hereinbefore described with reference to and/or as illustrated in any one or any combination of the Figures of the accompanying drawings.

15 19. A system for controlling the functionality of a user interface of a portable device, substantially as hereinbefore described with reference to and/or as illustrated in any one or any combination of the Figures of the accompanying drawings.

20 20. A display module for an electronic device, the display module comprising

 a display panel having a front face to be viewed by a user and a reverse face,

 an illuminator for illuminating the display panel,

25 a light detector for detecting light incident on at least part of the display panel, the light detector being positioned adjacent the reverse face of the display panel to detect light incident on the device, which light is the sum of ambient light and the light from the illuminator,

 a comparator for comparing the light detected with a given threshold,

30 and

 control means for controlling the illuminator in dependence on the output of the comparator.

21. A method of calibrating the lighting of a user interface of a device substantially as hereinbefore described with reference to and/or as illustrated in any one or any combination of the Figures of the accompanying drawings.

1 / 10

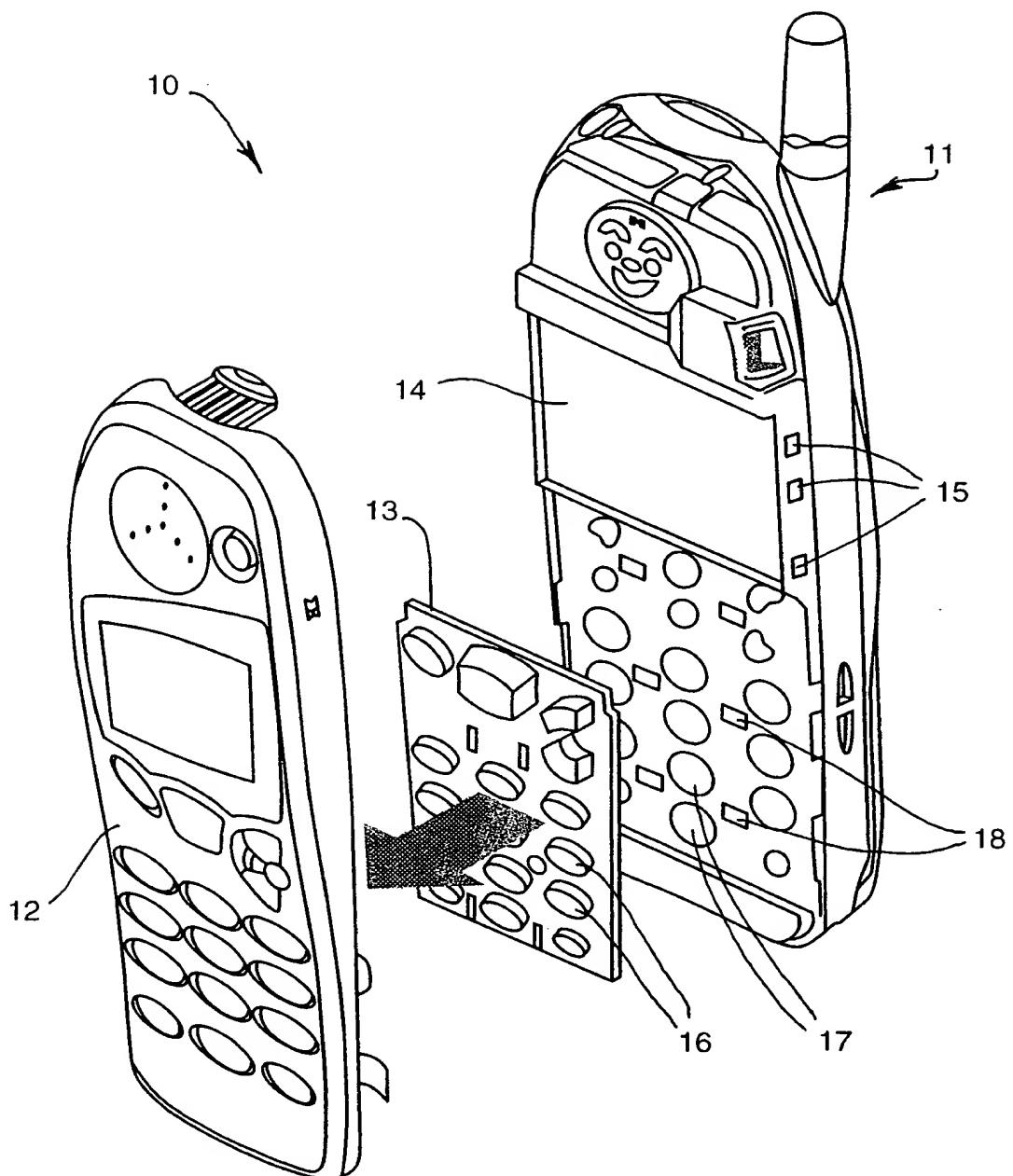


FIG. 1.

2 / 10

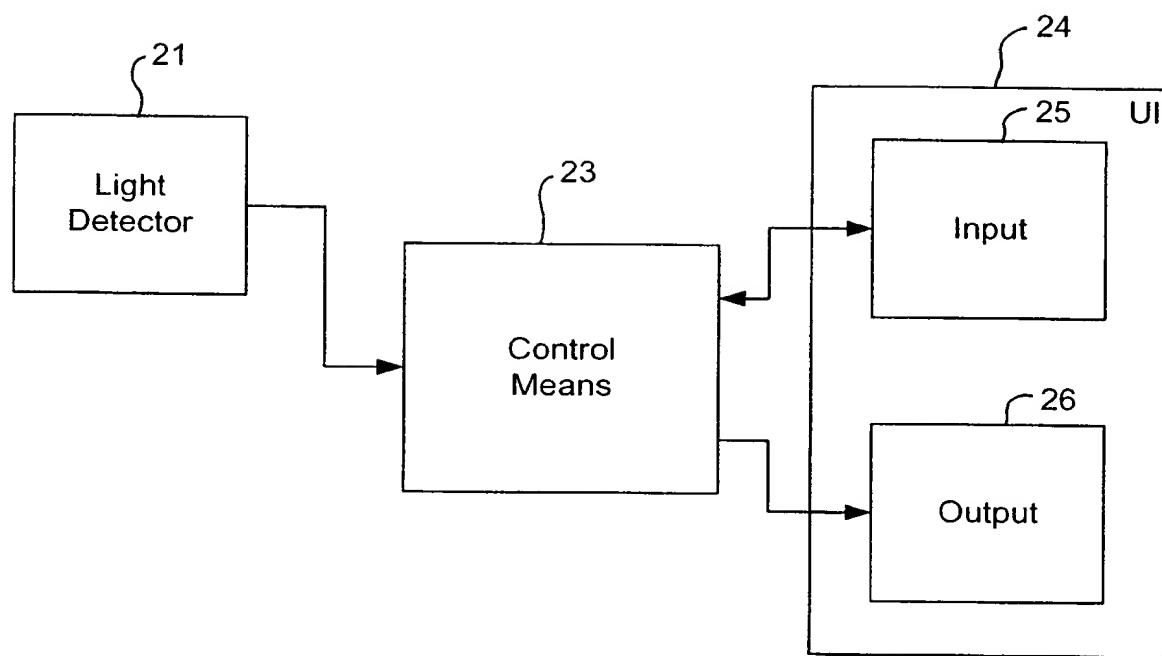


FIG. 2.

3 / 10

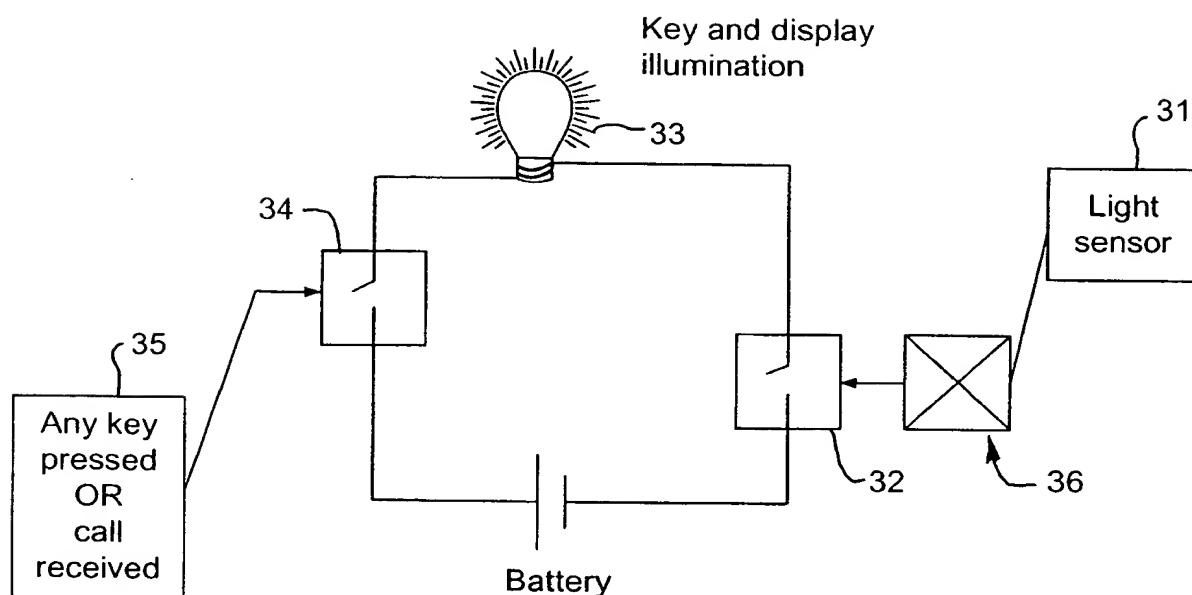


FIG. 3.

4 / 10

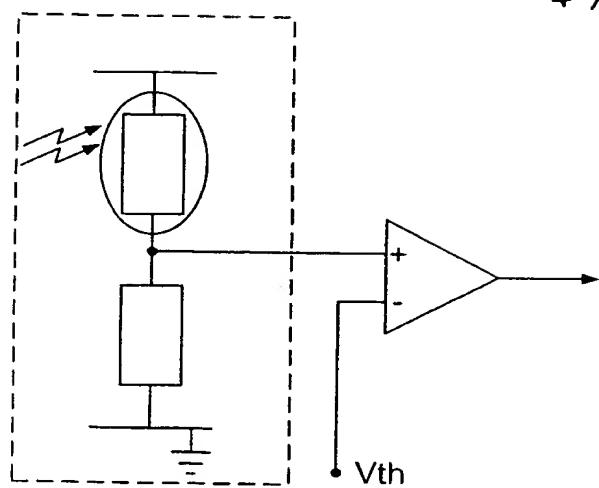
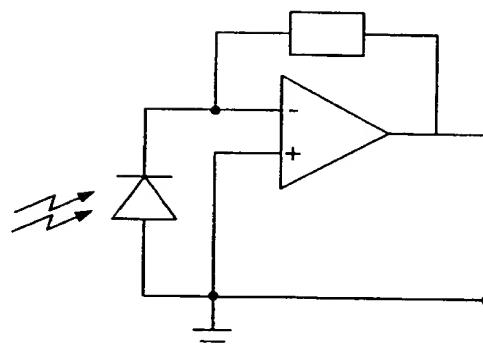
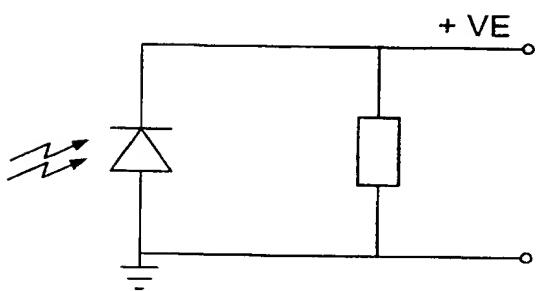
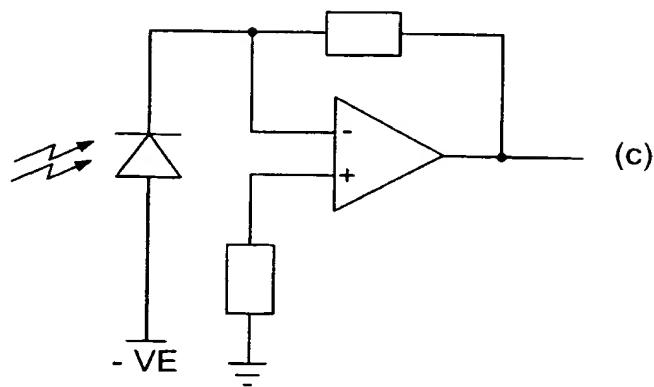
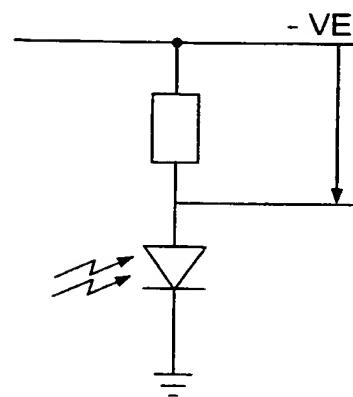


FIG. 4.

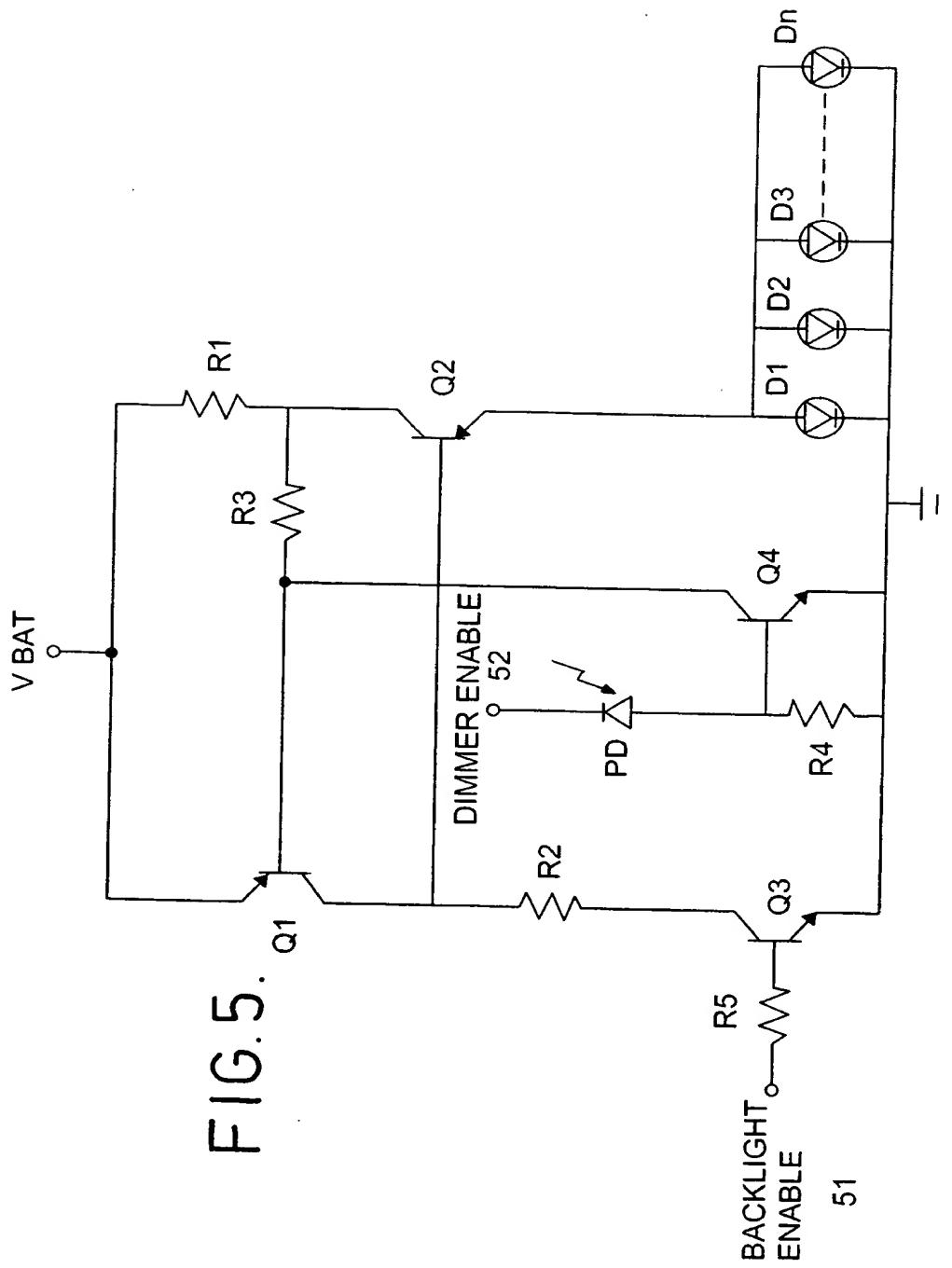
(a)



(b)



5 / 10



6 / 10

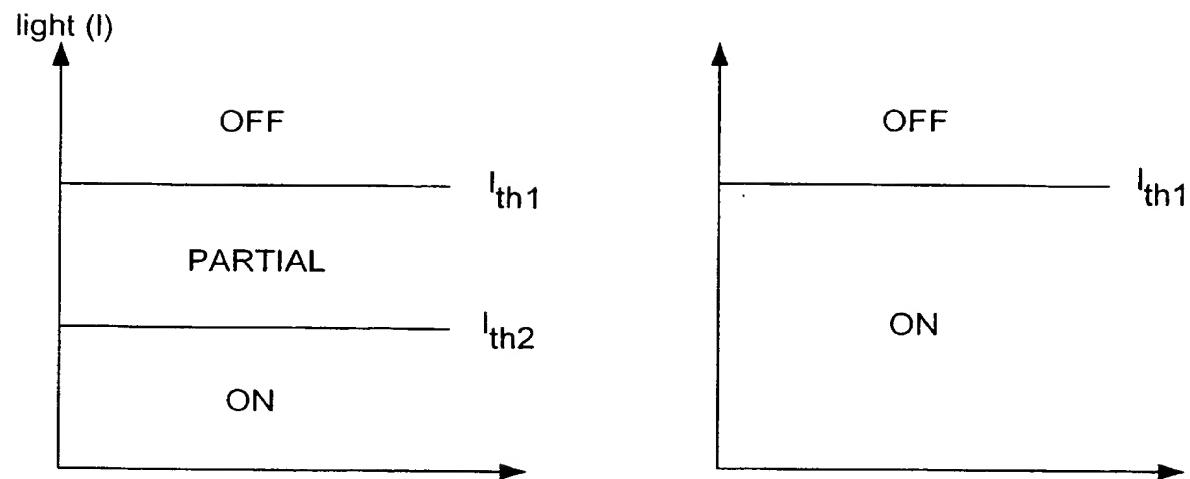


FIG. 6(a).

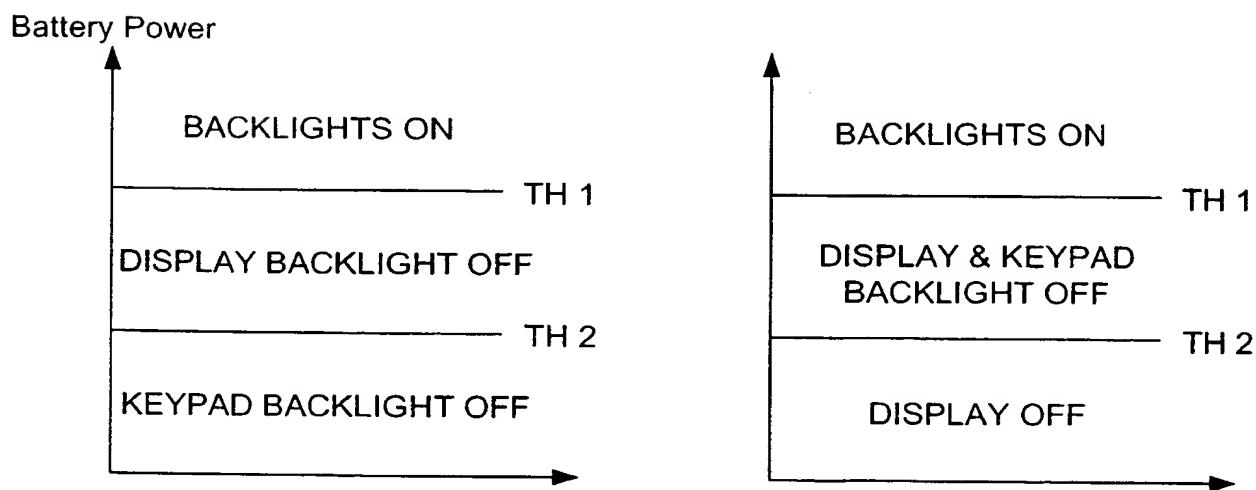


FIG. 6(b).

7 / 10

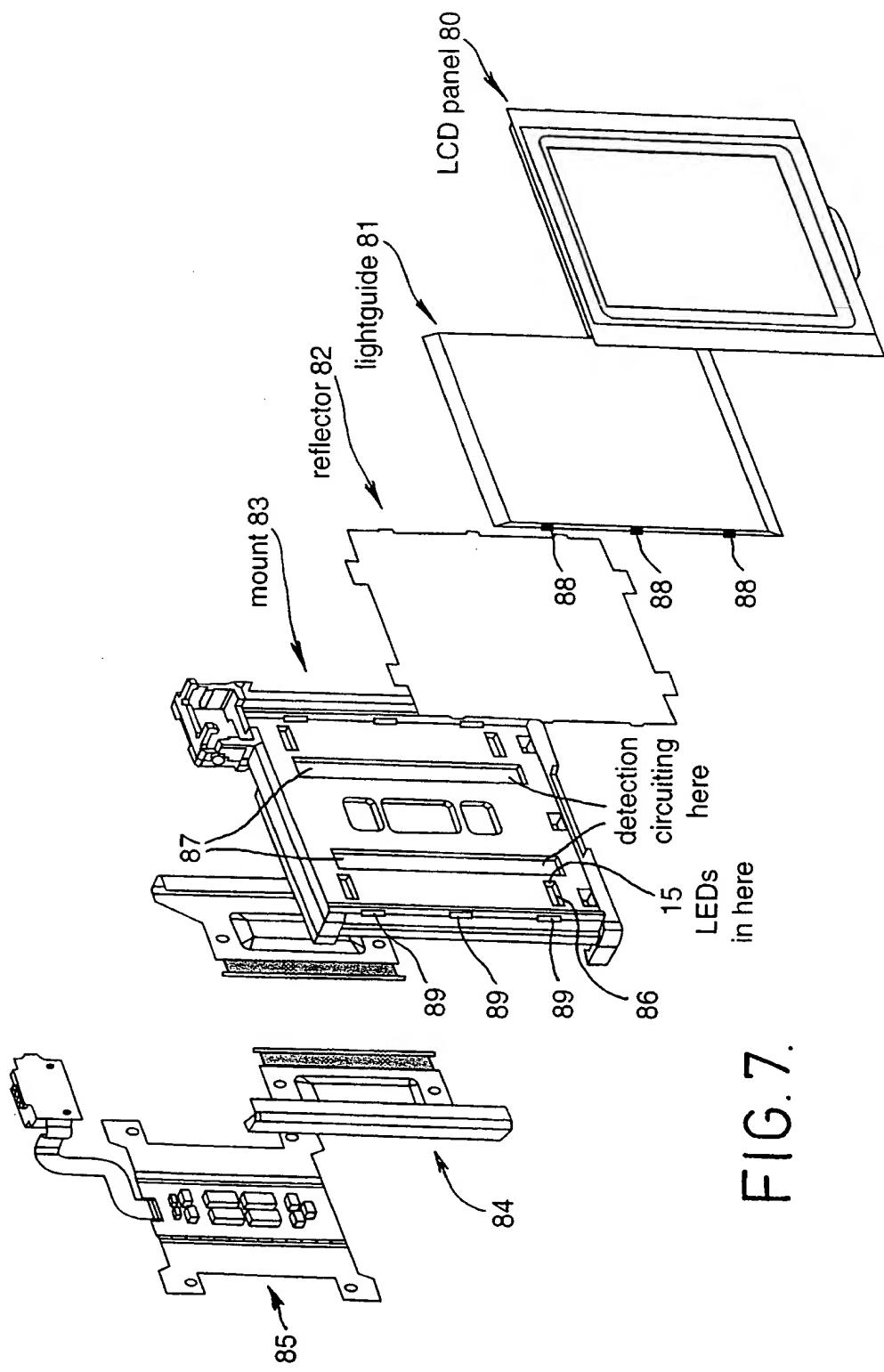


FIG. 7.

8 / 10

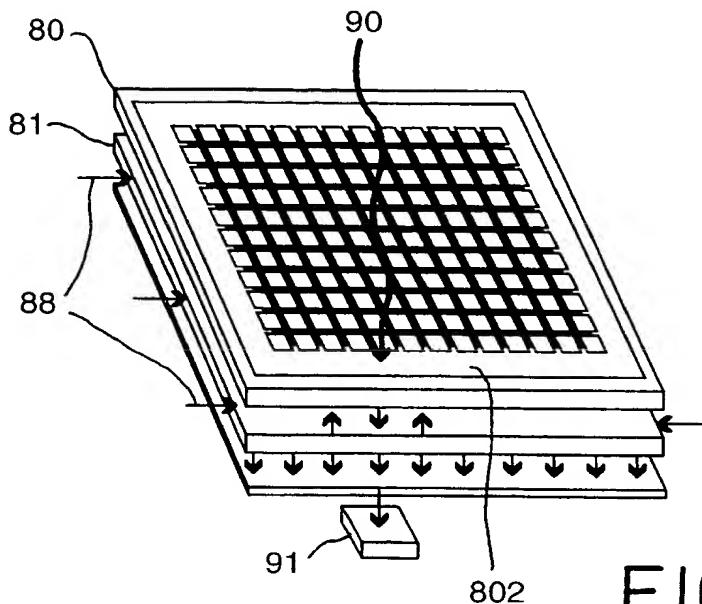


FIG. 8.

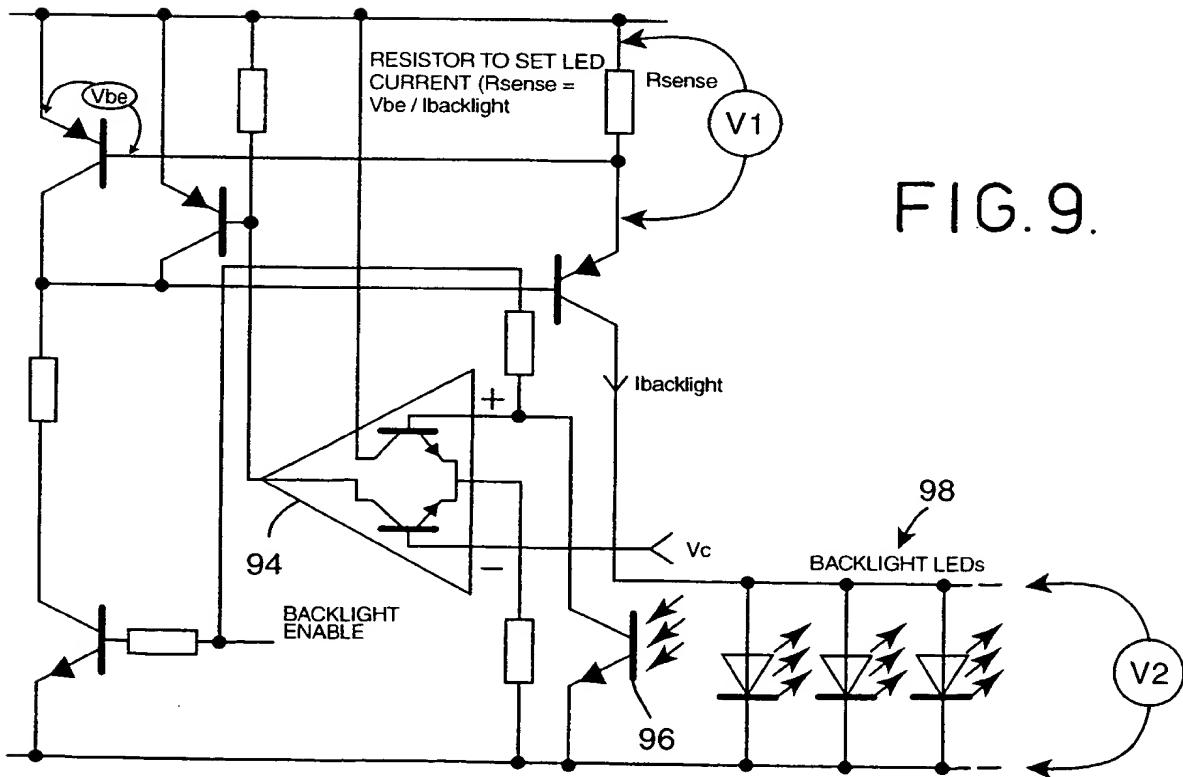
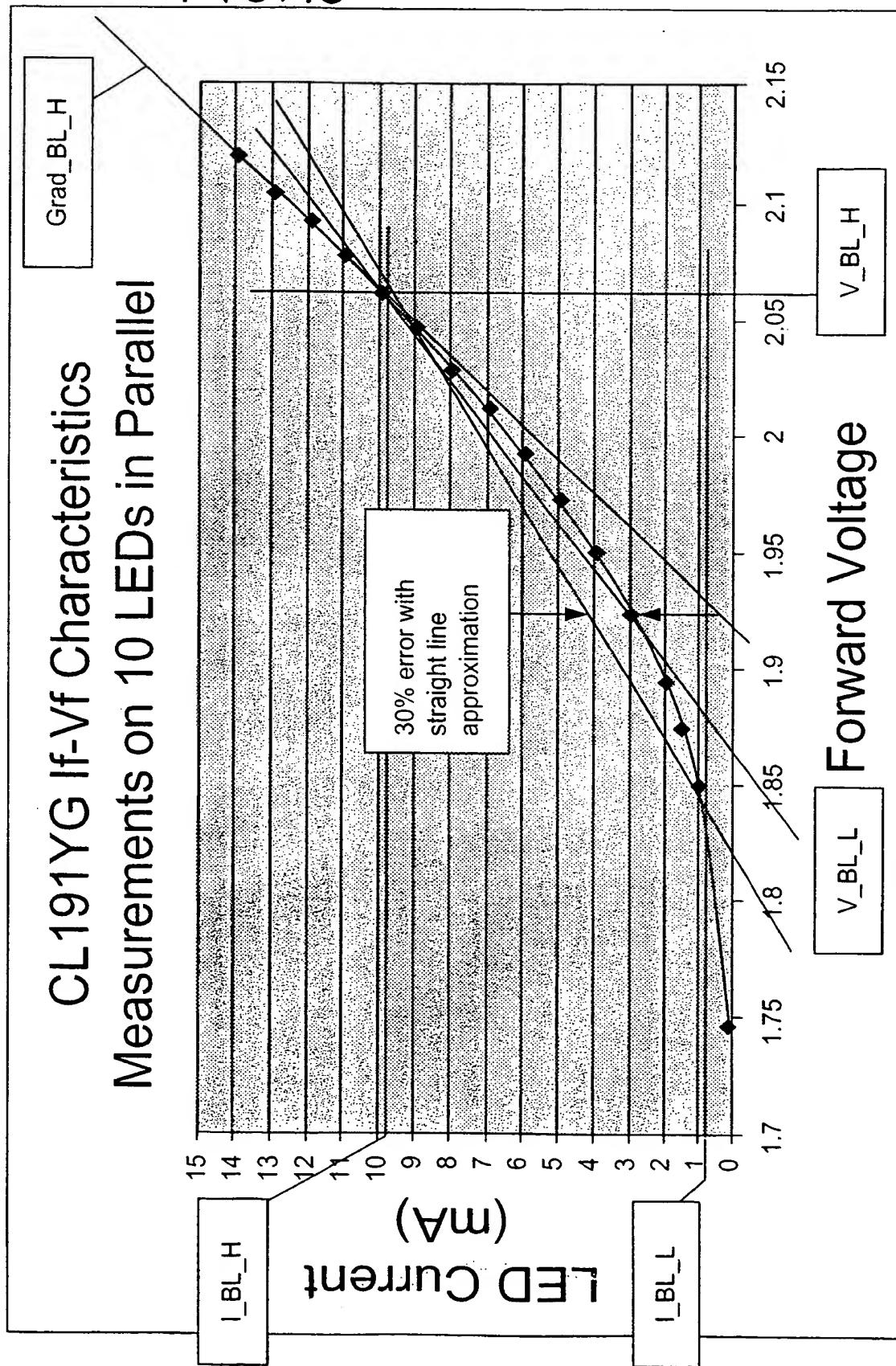


FIG. 10 9 / 10



10 / 10

PROFILES

1. Interactive
2. Meeting
3. Silent
4. Office

(a)

1. INTERACTIVE

- a) Automatic
- b) MID
- c) HIGH
- d) OFF

(b)

2. MEETING

- a) Backlighting
OFF
- b) LOW
- c) MID
- d) OFF

(c)

3. SILENT

- a) Backlighting
OFF
- b) MID
- c) LOW
- d) OFF

(d)

4. OFFICE

- a) Automatic
- b) LOW
- c) MID
- d) OFF

(e)

FIG.11.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/04446

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 H04M1/22 H04M1/02		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 H04M G09G G02F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 92 09163 A (UNIVERSAL CELLULAR INC) 29 May 1992 (1992-05-29) abstract page 5, line 8 -page 5, line 29 figures 1,4	1,2,4, 10-21
Y	—	3,5-9
X	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 09, 31 July 1998 (1998-07-31) & JP 10 096890 A (CASIO COMPUT CO LTD), 14 April 1998 (1998-04-14) abstract — —	1-3,16, 20
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.		<input checked="" type="checkbox"/> Patent family members are listed in annex.
• Special categories of cited documents :		
"A" document defining the general state of the art which is not considered to be of particular relevance		
"E" earlier document but published on or after the international filing date		
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)		
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention		
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone		
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.		
"Z" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
8 May 2000		16/05/2000
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel: (+31-70) 340-2040, Tx. 31 651 epo nl. Fax: (+31-70) 340-3016		Authorized officer Golzio, D

PCT**REQUEST**

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For Office use only

International Application No.

097869534

International Filing Date

09/08/97 34

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) **PAT 98032p*P****Box No. I TITLE OF INVENTION****A PORTABLE DEVICE****Box No. II APPLICANT**

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

NOKIA MOBILE PHONES LIMITED
KEILALAHDETIE 4
FIN-02150
ESPPO
FINLAND

 This person is also inventor.

Telephone No.

+358 24 3061

Facsimile No.

+358 24 3064 544

Teleprinter No.

State (that is, country) of nationality: **FI**State (that is, country) of residence: **FI**

This person is applicant all designated States all designated States except the United States of America the United States of America only the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

CHRISTOPHER ATKINSON
8 SOUTHWOOD ROAD
DUNSTABLE
BEDS
LU5 4EA
UK

This person is:

 applicant only applicant and inventor inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

GB

State (that is, country) of residence:

GB

This person is applicant all designated States all designated States except the United States of America the United States of America only the States indicated in the Supplemental Box

 Further applicants and/or (further) inventors are indicated on a continuation sheet.**Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE**

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

HIBBERT, JULIET JEFFERY, KENDRA HIGGIN, PAUL
FRAIN, TIMOTHY MUIR, HENRY HAWS, HELEN
NOKIA IPR DEPARTMENT, NOKIA HOUSE, SUMMIT AVENUE
FARNBOROUGH, HANTS GU14 0NG UNITED KINGDOM

Telephone No.

+441252865000

Facsimile No.

+441252865080

Teleprinter No.

Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

IAN LEWIS
7 SPENCER CLOSE
CHURCH CROOKHAM
FLEET HAMPSHIRE
GU13 0EG
UK

This person is:

applicant only
 applicant and inventor
 inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

GB

State (that is, country) of residence:

GB

This person is applicant for the purposes of:

all designated States

all designated States except the United States of America

the United States of America only

the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

IAN CAMERON
15 LONGBRIDGE ROAD
BRAMLEY
TADLEY
HANTS
RG7 5AN UK

This person is:

applicant only
 applicant and inventor
 inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

GB

State (that is, country) of residence:

GB

This person is applicant for the purposes of:

all designated States

all designated States except the United States of America

the United States of America only

the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

applicant only
 applicant and inventor
 inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:

all designated States

all designated States except the United States of America

the United States of America only

the States indicated in the Supplemental Box

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

This person is:

applicant only
 applicant and inventor
 inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

State (that is, country) of residence:

This person is applicant for the purposes of:

all designated States

all designated States except the United States of America

the United States of America only

the States indicated in the Supplemental Box

Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No. V DESIGNATION STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes, at least one must be marked).
 Regional Patent

AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT

OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

<input checked="" type="checkbox"/> AE United Arab Emirates	<input checked="" type="checkbox"/> LR Liberia
<input checked="" type="checkbox"/> AL Albania	<input checked="" type="checkbox"/> LS Lesotho
<input checked="" type="checkbox"/> AM Armenia	<input checked="" type="checkbox"/> LT Lithuania
<input checked="" type="checkbox"/> AT Austria	<input checked="" type="checkbox"/> LU Luxembourg
<input checked="" type="checkbox"/> AU Australia	<input checked="" type="checkbox"/> LV Latvia
<input checked="" type="checkbox"/> AZ Azerbaijan	<input checked="" type="checkbox"/> MD Republic of Moldova
<input checked="" type="checkbox"/> BA Bosnia and Herzegovina	<input checked="" type="checkbox"/> MG Madagascar
<input checked="" type="checkbox"/> BB Barbados	<input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia
<input checked="" type="checkbox"/> BG Bulgaria	<input checked="" type="checkbox"/> MN Mongolia
<input checked="" type="checkbox"/> BR Brazil	<input checked="" type="checkbox"/> MW Malawi
<input checked="" type="checkbox"/> BY Belarus	<input checked="" type="checkbox"/> MX Mexico
<input checked="" type="checkbox"/> CA Canada	<input checked="" type="checkbox"/> NO Norway
<input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein	<input checked="" type="checkbox"/> NZ New Zealand
<input checked="" type="checkbox"/> CN China	<input checked="" type="checkbox"/> PL Poland
<input checked="" type="checkbox"/> CU Cuba	<input checked="" type="checkbox"/> PT Portugal
<input checked="" type="checkbox"/> CZ Czech Republic	<input checked="" type="checkbox"/> RO Romania
<input checked="" type="checkbox"/> DE Germany	<input checked="" type="checkbox"/> RU Russian Federation
<input checked="" type="checkbox"/> DK Denmark	<input checked="" type="checkbox"/> SD Sudan
<input checked="" type="checkbox"/> EE Estonia	<input checked="" type="checkbox"/> SE Sweden
<input checked="" type="checkbox"/> ES Spain	<input checked="" type="checkbox"/> SG Singapore
<input checked="" type="checkbox"/> FI Finland	<input checked="" type="checkbox"/> SI Slovenia
<input checked="" type="checkbox"/> GB United Kingdom	<input checked="" type="checkbox"/> SK Slovakia
<input checked="" type="checkbox"/> GD Grenada	<input checked="" type="checkbox"/> SL Sierra Leone
<input checked="" type="checkbox"/> GE Georgia	<input checked="" type="checkbox"/> TJ Tajikistan
<input checked="" type="checkbox"/> GH Ghana	<input checked="" type="checkbox"/> TM Turkmenistan
<input checked="" type="checkbox"/> GM Gambia	<input checked="" type="checkbox"/> TR Turkey
<input checked="" type="checkbox"/> HR Croatia	<input checked="" type="checkbox"/> TT Trinidad and Tobago
<input checked="" type="checkbox"/> HU Hungary	<input checked="" type="checkbox"/> UA Ukraine
<input checked="" type="checkbox"/> ID Indonesia	<input checked="" type="checkbox"/> UG Uganda
<input checked="" type="checkbox"/> IL Israel	<input checked="" type="checkbox"/> US United States of America
<input checked="" type="checkbox"/> IN India	<input checked="" type="checkbox"/> UZ Uzbekistan
<input checked="" type="checkbox"/> IS Iceland	<input checked="" type="checkbox"/> VN Viet Nam
<input checked="" type="checkbox"/> JP Japan	<input checked="" type="checkbox"/> YU Yugoslavia
<input checked="" type="checkbox"/> KE Kenya	<input checked="" type="checkbox"/> ZA South Africa
<input checked="" type="checkbox"/> KG Kyrgyzstan	<input checked="" type="checkbox"/> ZW Zimbabwe
<input checked="" type="checkbox"/> KP Democratic People's Republic of Korea	
<input checked="" type="checkbox"/> KR Republic of Korea	
<input checked="" type="checkbox"/> KZ Kazakhstan	
<input checked="" type="checkbox"/> LC Saint Lucia	
<input checked="" type="checkbox"/> LK Sri Lanka	

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

.....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)

Box No. VI PRIORITY CLAIMS

Further priority claim is indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 31/12/1998	9828878.0	GB		
item (2) 10/06/1999	9913540.2	GB		
item (3)				

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s):

* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA)
(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA / EP

Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):

Date (day/month/year)

Number

Country (or regional Office)

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:

request : 4
description (excluding sequence listing part) : 18
claims : 4
abstract : 1
drawings : 10
sequence listing part of description : 1

Total number of sheets : 37

This international application is accompanied by the item(s) marked below:

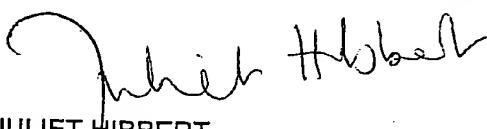
- fee calculation sheet
- separate signed power of attorney
- copy of general power of attorney; reference number, if any
- statement explaining lack of signature
- priority document(s) identified in Box No. VI as item(s):
- translation of international application into (language):
- separate indications concerning deposited microorganism or other biological material
- nucleotide and/or amino acid sequence listing in computer readable form
- other (specify):

Figure of the drawings which should accompany the abstract: 8

Language of filing of the international application: ENGLISH

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).



JULIET HIBBERT

For receiving Office use only	
1. Date of actual receipt of the purported international application: 3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application: 4. Date of timely receipt of the required corrections under PCT Article 11(2): 5. International Searching Authority (if two or more are competent): ISA /	
6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.	
2. Drawings: <input type="checkbox"/> received: <input type="checkbox"/> not received:	

For International Bureau use only	
Date of receipt of the record copy by the International Bureau:	

PAT 98032p US

A Portable Device

5 The present invention relates to hand held devices such as radiotelephones, and in particular to the illumination and operability of the user interface of such devices.

Hand held devices such as radiotelephones conventionally have their user 10 interface (e.g. display and keys) illuminated, to enable their use in the dark. However, backlighting of such input and output devices causes a drain on the battery of the device. Devices are known which conserve battery power by only illuminating the display and keypad lights for a predetermined period (e.g. 15 seconds) after a key press or incoming call.

15 According to the present invention, there is provided a portable device comprising: a user interface; a light detector for detecting the light incident on at least part of the user interface; a comparator for comparing the light detected with a given threshold; and control means for controlling an 20 illuminator for illuminating the user interface in dependence upon the output of the comparator.

Thus the invention provides both control of a user interface (e.g. a display 25 and keyboard) backlighting to save power when the ambient light level is high and to control the backlighting brightness when the ambient light level is low. This is particularly important in mobile telephones that have web browsing and game capabilities where the display may be being viewed for long periods.

30 The photosensor preferably feeds an amplifier whose output controls the drive level of the illuminator and whose gain can be controlled to vary the light

sensitivity threshold. Preferably the photosensor is placed under the border area of a display where it receives not only ambient light but also some light scattered by the diffuser used to distribute light from the illuminator evenly across the display. This location of the sensor gives the following benefits:-

5

1. The sensor in this location is least likely to be obscured by a user, being in an area viewed by the user. As devices such as phones get smaller, other locations are likely to suffer from light being obscured by the user's hand with consequential annoying illumination level fluctuations and reduced 10 operating times.

15

2. Backlighting is primarily needed for display illumination therefore positioning the photosensor under the display is the prime location where ambient light received by the sensor represents the true ambient light level illuminating the display. This prevents shadows and uneven lighting from fooling the light detector as the backlight level will only respond to changes in ambient light actually entering the display.

20

3. Integration of backlight brightness control into the light sensitivity control giving the user a single up/down illumination level is possible if the sensor is positioned such that it receives a light level that represents the total light contributing to display illumination which is the sum of both backlight and ambient light. The best location where this is possible is behind the display.

25

This scheme obviates the need for two user controls, one for backlight brightness and another for light sensitivity threshold, which would require more complex software and hardware to control.

30

The invention saves battery power by reducing display backlighting brightness when ambient light level is high and also provides user control backlighting intensity when ambient light level is low. This is particularly

important in mobile telephones that have web browsing and game capabilities where the display may be being viewed for long periods.

Sensing light via the display allows the ambient light control to seamlessly 5 control the backlight brightness in low ambient light conditions by simply increasing the sensitivity level to detect the light scattered from the backlight diffuser. For example, a user equipped with a phone with separate brightness control may try to adjust the brightness but if the ambient light level is high the ambient light detection will turn off the backlight so the user will have a 10 feature which appears to do nothing. However, light sensing through the display senses the total illumination light level rather than just ambient light.

The invention also relates to a method of calibrating the sensitivity levels of a light detector. Having the light detector located to receive both the ambient 15 light and the light from the illuminator means that the illuminator can be used to calibrate the light detector. This obviates the need for an external light source for calibration purposes.

If an external light source were to be used instead, the source would need to 20 be switchable but such light sources may require time to stabilise (e.g. 30 seconds which is too long for production techniques). This is not the case with the illuminators used with portable devices such as mobile telephones.

The light detector is advantageous as it provides efficient power conservation 25 due to its detection of actual light, whether it be day light or artificial light.

The control means may turn the user interface illuminator off, for example, if the light exceeds a threshold. That is the illuminator is turned off when there is sufficient light for a user to see the user interface, and on when there is 30 insufficient light. Preferably, the device also compares the light detected with a second lower threshold. In such an embodiment, the illuminator is off if the

light detected is above the first threshold, on if it is below the second threshold, and variable if it is between the two. Examples of variable illumination include only back lighting one or other of a user input and user output of the user interface (for example a keyboard and display), or by 5 varying the intensity of the illumination.

Furthermore, the output of the light detector may be compared over a predetermined period (e.g. 30 seconds) to determine whether any change in intensity is found. A determination of no such change can be used as an 10 indication that the device is not currently being used; for example it may be in a pocket, brief case or remote from the user etc. In this event, the illuminator and/or user interface may be suspended.

The device may operate in different modes, depending on the desired profile. 15 Profiles may include outdoor, meeting, office etc. Consequently, such a device may take into account artificial light conditions, and thus improve power conservation. For example, the backlighting default for the meeting and office profiles may be off.

20 Selection of the desired profile may be altered manually by the user, or if the device has a calendar, it could be linked to the calendar's contents.

Further, the device is arranged so that the user can personalise the backlighting settings via the user interface.

25 Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, of which:

Figure 1 is an exploded view of a radio telephone which may implement the present invention;

30 Figure 2 is a block diagram of a device whose operation depends on light detection according to an embodiment of the present invention;

Figure 3 shows light detection circuitry according to an embodiment of the present invention;

Figures 4a to 4c show examples of light detectors which could be incorporated in device of the present invention;

5 Figure 5 illustrates light detection circuitry according to a preferred embodiment of the present invention;

Figures 6a and 6b illustrate methods of operation of a device depending upon light detection;

Figure 7 shows an exploded view of a display module according to the 10 invention;

Figure 8 shows a perspective view of the arrangement shown in Figure 7; and Figure 9 shows the typical forward current-forward voltage characteristics of a phototransistor; and

Figure 10 illustrates light detection circuitry according to a further 15 embodiment of the present invention.

Figure 1 is an exploded view of a substantial part of a radio telephone 10, comprising a main body 11, front cover 12, and keymat 13. The keymat 13 comprises an array of depressible keys 16 and may, for example, be made 20 from a single piece of silicon rubber. The upper surfaces of the keys include an indicia region which is marked so as to bear an indicia serving to indicate the functionality of the keys, e.g. alphanumeric character or other symbol. The main body 11 comprises a circuit board having an array of electrical contact regions (not shown) corresponding to the keys 16. A contact 25 membrane provides an array of domed contact elements 17 made from metal. Each contact element is arranged to lie intermediate to key 16 and its corresponding electrical contact region. Each key 16 has a projection depending centrally from its rear and when a key is depressed this projection causes the corresponding domed contact element 17 to snap from a first 30 natural bias position in which electrical connection is not effected to a second

distorted position in which the contact element causes an electrical connection to be made.

The circuit board also comprises light emitting diodes (LEDs) 18 for 5 backlighting the keys. The membrane has holes corresponding in position to the LEDs, and the silicon rubber keymat is preferably translucent. Further, it is preferable for the rear of the keymat 16 to be moulded to provide a light guide from an LED 18 to a surrounding group of keys 16, so as to provide even backlighting.

10

The main body 11 also comprises a liquid crystal display (LCD) module 14. A row of LEDs 15 is provided on each side of this display so as to illuminate it.

15

The LCDs 15, 18 may be connected to the same or different control circuitry depending upon device requirements. Likewise, the keymat LCDs 18 may be controlled individually, as a group, or all together.

A method of controlling the LCDs using a transducer in accordance with an embodiment of the invention will now be described with reference to Figure 2.

20

The device of Figure 2 comprises transducers in the form of a light detector 21. The device also comprises control means 23, and a user interface 24, having an input 25 and output 26. The input may, for example, be a keypad as in Figure 1, or alternatively a touch screen, voice detector or the like. The 25 output may, for example, be a display as in Figure 1, or alternatively a loudspeaker or the like.

The control means 23 controls functionality relating to the user interface, depending upon the output of the light detector 21 as follows.

30

The light detector 21 detects the level of light surrounding the device, converts it into a corresponding electrical signal and forwards it to the control means 23. The control means 23 stores the threshold level at which backlighting should be switched on/off and compares the detected light signal 5 with this threshold. A detected light signal above the threshold is an indication of sufficient natural/artificial daylight and thus the backlighting is switched off. On the other hand, a detected light signal below the threshold is an indication of darkness, and consequently, the control means 23 turns the input and output backlighting on. In this event, the control means may switch 10 the backlighting permanently on. Alternatively, it may be arranged so as to only turn the backlighting on in certain circumstances, such as in response to an input by the user (e.g. key depression) or an incoming call.

If the control means 23 determines that the surroundings are dark, it 15 preferably also samples the detected light signal over a predetermined period. If no variation is detected, it is assumed that the device is in a pocket, brief case etc. In this event, the control means 23 turns the backlighting and the output 26 off.

20 The light detector 21 is discussed in more detail below with reference to Figures 3 to 5. However, it may be positioned in a device for example anywhere in which it can detect external light and the light scattered by at least some of the LEDs 16, 18. In a radiotelephone, for example, it may be provided in the vicinity of the display backlighting LEDs.

25 Figure 3 illustrates a schematic diagram of the operation of key and display backlighting according to an embodiment of the present invention.

It is a series circuit comprising a battery, illuminator 33 and two switches, 30 referenced 32 and 34. Switch 32 is operated under control of a control means on the basis of the output of a light detector 31, and switch 34 is

operated depending on other circumstances, 35, namely when a key is depressed or call received. Only when both switches are closed will the illuminator 33 turn on.

5 Control means 36 closes switch 32 if the light sensor 31 detects insufficient light.

Switch 34 is closed in response to an input, such as when a key is depressed or a call is received. Preferably, this switch 34 is closed for a predetermined 10 period (e.g. 15 seconds) after the input and then reopens.

Consequently, only when the device is in sufficiently dark surroundings and an input is received will the illuminator 33 illuminate. As a result, power is conserved, resulting in an increase in operational time of the device.

15 The light detection part of this circuit operates according to Figure 6b. That is, the control means 36 compares the light detected by the light sensor 31 with a threshold L_{TH1} . If the light detected is above this threshold the switch is open and backlighting is off, whereas if it is below the threshold, the switch 20 is closed and the backlighting is on (when switch 34 is closed). However, the light sensor 31 and switch 32 may be replaced by variable sensor, and the control means 36 arranged to operate according to the illustration of Figure 6a. In this case, the control means 36 stores two threshold values, one 25 indicative of minimum sufficient daylight, L_{TH1} , and one indicative of minimum night light, L_{TH2} . If there is sufficient daylight the backlighting is off, if it is dark the backlighting is on (assuming switch 34 is closed) and if the light detected is between the two (for example dusk) then the backlight is partially illuminated (again assuming switch 34 is closed). Partial illumination may 30 mean illumination of the display and not the keypad, or it may mean only some of the LED's of the backlighting are illuminated. However, preferably it means that the intensity of the backlighting is inversely proportional to the

light level detected i.e. it increases in intensity from the lowest threshold when it reaches L_{TH1} to maximum illumination when it reaches L_{TH2} .

5 Figure 4 illustrates typical light sensors which may be used in the device of the present invention. Figure 4a illustrates a photo resistor, and Figures 4b and 4c illustrate photodiode arrangements.

10 Figure 5 illustrates in more detail light detection circuitry according to an embodiment of the present invention. Operation of this circuit depends on the signal input to two inputs, a backlighting enable input 51 and a dimmer enable input 52. These inputs may be set by the user, for example by way of a menu option of the device. The circuitry provides an integrated light detection and backlight control means, and operates as follows. If the backlight input 51 receives a backlight disable signal (low), transistor Q3 switches. Transistor 15 Q2 is biased so that in this event it too is switched off and, consequently, backlighting LEDs D1 to Dn are off. The signal applied to the dimmer input is irrelevant in this instance.

20 In contrast, if the backlighting input 51 receives a backlighting enabled signal (high), transistor Q3 is turned on, which in turn results in transistor Q2 turning on. Consequently, the backlighting LEDs D1 to Dn obtain the necessary current to turn on. The intensity of these LEDs is determined by the signal applied to the dimmer input 52. If the signal is a dimmer disable signal, current is not drained from the collector of transistor Q2 and therefore the 25 backlighting LEDs D1 to Dn illuminate at maximum intensity.

30 When the dimmer is enabled, on the other hand, transistor Q4 is switched on and the amount of current drained from the collector of transistor Q2 depends upon the level of light detected by the photodiode PD. The less light detected the less current the photodiode draws, resulting in more illumination by the backlighting LEDs D1 to Dn.

The dimmer input may be varied in response to a user input (e.g. a user selecting the amount of illumination) or in response to a profile selected by a user or in response to the light detected by the light detector.

5

Figure 7 shows an exploded view of a display module in accordance with the invention for use with a device. The display module comprises a LCD panel 80, a diffuser in the form of a lightguide 81, a reflector 82, a mount 83 and PCB connectors 84 and 85. Information is displayed on the LCD panel 80.

10 The lightguide 31 diffuses the light emitted by the LEDs 15 which are positioned within apertures 86 of the mount 83. Apertures 89 provide a light path from the LEDs to the lightguide 81. The mount 83 is also provided with apertures 87 for the location of at least one phototransistor.

15 Figure 8 shows a perspective view of the display arrangement shown in Figure 7. The phototransistor 91 is placed under the border area 802 of the display where it receives not only ambient light but also some light from the LEDs 15 which enters the diffuser 81 by means of apertures 88. In this position the phototransistor is least likely to be obscured by a user when the 20 device is in use. The phototransistor therefore receives a light level that represents the total light contributing to display illumination which is the sum of both the backlight and the ambient light incident on the display. Arrow 90 indicates the light path to the sensor 91.

25 The photosensor 91 is located such that it receives approximately equal proportions of ambient light and backlight in relation to their contribution to display illumination, the total of which is therefore maintained at a constant level as any deficit in ambient light below the preset amplifier threshold is compensated for by an increase in backlight drive levels. Therefore with no 30 ambient light the amplifier threshold merely controls backlight intensity which is the key to the calibration method described below as the backlight as a

visible and easily measurable indicator of the light detector sensitivity. The backlight brightness or corresponding drive level can be measured in one of three ways. 1) light meter or imaging system, 2) supply current measurement or 3) backlight drive voltage or current measured by appropriate hardware 5 and software within the device.

The photosensor 91 feeds an amplifier that has a controllable threshold (as described above and below). The output of the amplifier is then used to control the backlight drive level in such a way that the backlight intensity is 10 reduced if the light level received by the sensor is above a pre-set threshold, of which there may be many selectable by a user. These thresholds require calibration owing to component tolerance variations and a method of carrying out the calibration is described below.

15 Figure 9 shows a further example of light detection circuitry in accordance with the invention. The light detection circuitry uses the voltage developed across a current sense resistor R_{sense} in series with the LED array 98 to turn on a transistor when this voltage equals the base-emitter junction voltage V_{be} . This transistor is configured to divert base current from the LED drive 20 transistor and hence limit the total backlight current to $I_{backlight} = V_{be}/R_{sense}$.

The light detector does not affect the constant current part of the LED drive except to back off the drive level to the base of the LED drive transistor when the ambient light is high enough.

25 A discrete transistor comparator 94 compares a controllable reference voltage V_c with the voltage across a pull-up resistor R_p providing current for the phototransistor 96. This sets the current for the phototransistor 96 and hence the light level threshold for detection with the higher reference voltages 30 relating to lower phototransistor current and hence higher sensitivity to light. Lowering the sensitivity by reducing the control voltage V_c will therefore result

in a higher ambient light level threshold. The output of the comparator 94 drives the constant current LED circuit 98. The control voltage is generated by an electronic circuit such as an analogue-to-digital converter which is arranged to generate a plurality (e.g. 32) approximately equal voltage steps 5 between 0V and Vbb. An example of these is shown in the table below:

Step	Voltage	Step	Voltage	Step	Voltage	Step	Voltage
01	88.2 mV	09	795	17	1502	25	2209
02	176	10	883	18	1590	26	2297
03	265	11	971	19	1678	27	2386
04	353	12	1060	20	1767	28	2474
05	442	13	1149	21	1856	29	2563
06	530	14	1237	22	1944	30	2651
07	618	15	1325	23	2032	31	2740
08	707	16	1413	24	2121	32	2832

The design of the light detector circuit of Figure 9 is such that the control voltage V_c must exceed a voltage equal to the V_{be} of the transistor before it 10 can operate. Steps 01 to 06 therefore have no effect and actually disable the ambient light compensation which means that the backlight will be fully on. It is however recommended that the step 00 (0mV) be used for the purpose of 15 disabling the ambient light detector 21 since any other value will prevent the device from entering the sleep mode. Preferably only control steps values above step 10 should be used as this gives sufficient voltage margin above V_{be} to ensure satisfactory light detection, taking temperature fluctuations into account.

Typical forward current-forward voltage characteristics of a photodetector PD 20 are shown in Figure 10 and, as can be seen, these are non-linear. A straight line approximation would give unacceptable errors. Therefore a good

approximation has been found by measuring/calibrating the LED array voltages V_{BLH} and V_{BLL} for the backlight (BL) at two extreme currents (I_{BLH} (maximum brightness) and I_{BLL} (minimum brightness)) and then assuming that the gradient changes linearly between these two points. The gradient 5 calculation based on the LED voltage would then be based on the gradient of a straight line. V_{BLL} (the LED voltage when the LED current produces minimum brightness) and V_{BLH} (the LED voltage when the LED current produces maximum brightness) are suitable calibration points. Therefore a straight line approximation for LED current I based on a LED voltage of V 10 would be:

$$I = I_{BLH} - \text{Grad}(V_{BLH} - V) \quad (1)$$

A more accurate approximation can be found by substituting a gradient calculation that gives a gradient that changes linearly with LED voltage between the steepest gradient (GRAD BLH) at the upper calibration point and 15 the gradient between the upper and lower calibration points, i.e. :

$$\text{Grad} = \text{Grad BLH}(1 - (V_{BLH} - V)/C) \quad (2)$$

where C is a gradient coefficient.

20 Combining equations 1 and 2 gives the following equation for the backlighting current:

$$I = I_{BLH} - ((V_{BLH} - V) * \text{Grad BLH} * (1 - (V_{BLH} - V)/C)) \quad (3)$$

25 The gradient coefficient can be derived from by re-arranging equation 3 and substituting the low calibration points V_{BLH} and I_{BLH} in place of V and I respectively i.e.:

$$C = \frac{V_{BLH} - V_{BLL}}{1 - \frac{I_{BLH} - I_{BLL}}{Grad_{BLH} (V_{BLH} - V_{BLL})}}$$

Calibration measures the maximum backlight drive level. This can be determined by measuring V1, V2 (see Figure 9) or by using a light meter.

Depending on the level and number of thresholds to be calibrated the 5 detector is enabled and the sensitivity adjusted until each of the required backlight levels are achieved. For example, to calibrate three ambient light threshold levels corresponding to 25%, 50% and 75% of maximum backlight level with a maximum backlight current of 100 mA using current measurement would involve increasing the sensitivity and noting the sensitivity when the 10 backlight current falls to 75mA, 50mA and 25mA respectively. When the user changes the ambient light settings the backlight brightness changes in steps approximately equal to 25% of maximum backlight brightness in darkness or up to the level determined by the background light level.

15 Calibration uses the backlight as the light source for calibration. This results in an ambient light calibration that is relative to the maximum light output of the light source. This has the advantage that in low ambient light situations, the illumination steps can be equal whereas, if an external light source were used, there may be a disproportionately large change in illumination between 20 steps.

The following steps calibrate the output of the backlight and also the sensitivity control of the light detector:

1. Maximum current calibration

25 1.1. Set the backlight control voltage to step 01 (i.e. light source OFF (but not in sleep mode))

 1.2. Phone current (i.e. between battery terminals) = Local Mode Current

- 1.3. Turn light source full on (i.e. set control voltage to step 10)
- 1.4. LED drive level (i.e. the voltage across the backlight LED array) = V_{BLH} . (The drive level is also used to calculate battery capacity)
- 1.5. Phone current = Full on Current
- 5 1.6. I_{BLH} = Full on Current - Local Mode Current
- 1.7. Fail if I_{BLH} is greater than 230mA or less than 150mA or if V_{BLH} is less than 846mV or greater than 1006mV.
2. Minimum current calibration
- 10 2.1. Set the control voltage to step 1E (i.e. off)
- 2.2. Read the LED drive level
- 2.3. If LED drive level < 1.6 V, LEDs are off so decrement the control voltage and repeat steps 2.2 to 2.3
Else V_{BLL} = LED drive level
- 15 LEDs are now driven at minimum brightness
- 2.5. Measure phone current
- 2.6. I_{BLL} = Measured phone current - Local mode current
- 2.7. Fail if I_{BLL} is less than 65mA or if V_{BLL} is less than 2297mV
- 20 3. Backlight I-V gradient and High, Mid and Low settings

The backlight is calibrated to give three levels of illumination between full on and off. These are indicated below as ADL_LIGHT (control value at lowest sensitivity (high illumination level)), ADL_MID (control value at mid point 25 between ADL_LIGHT and ADL_DARK) and ADL_DARK.(control value at highest sensitivity (low illumination level)). These levels may be then be selected by a user either directly (e.g. from a menu) or by means of a profile selection.

- 30 3.1. Let ADL_LIGHT= 12 (i.e. the LEDs are full on)
- 3.2. V_{BL} = LED drive level

3.3 If $V_{BL} > V_{BLH} + 0.8(V_{BLH} - V_{BLL})$ increment ALD_LIGHT and repeat steps 3.2 and 3.3

Else set $V_{BL} = V_{BL_LIGHT} \Rightarrow ALD_LIGHT$

ALD_LIGHT is the setting giving approximately 75% of maximum drive in dark conditions.

3.4 Measure phone current

3.5 $I_{BL} =$ Measured phone current - Local mode current

3.6 Calculate I-V gradient $GradBLH = (I_{BLH} - I_{BL}) / (V_{BLH} - V_{BL})$

10

3.7 $ALD_MID = ALD_LIGHT$

3.8 Increment ALD_MID

3.9 $V_{BL} =$ LED drive level

3.10 If $V_{BL} > V_{BLL} + 0.75(V_{BL_LIGHT} - V_{BLL})$ repeat steps 3.8 to 3.10

15

Else $V_{BL} = V_{BL_MID} \Rightarrow ALD_MID$

ALD_MID is the setting giving approximately 50% illumination relative to the maximum brightness.

3.11 $ALD_DARK = ALD_MID$

20

3.12 Increment ALD_DARK

3.13 $V_{BL} =$ LED drive level

3.14 If $V_{BL} > V_{BLL} + 0.4(V_{BL_LIGHT} - V_{BLL})$ repeat steps 3.12 to 3.14

Else $V_{BL} = V_{BL_DARK} \Rightarrow ALD_DARK$

ALD_DARK is the setting giving approximately 25% illumination relative to the

25

maximum brightness.

ALD_DARK, ALD_MID and ALD_LIGHT and GradBLH have now all been calibrated and are stored in the memory of the device for selection by a user or a profile.

30

In the preferred embodiment, the user can set the user interface to function in a desired manner for different operating environments. Typical profiles may include outdoor, meeting, silent and office environments. Backlighting options for these profiles may be seen in Figure 11.

5

Figure 11a illustrates a profiles menu, and Figures 11b to e illustrate the options available within those profiles. In each case, option a is the default option. Take, for example, the interactive mode shown in Fig. 11b. The default option is "automatic" i.e. the light detector for backlighting is on all the time. However, in the event that the user wishes to conserve power and yet still wishes to be able to see the user interface in the dark, he may choose to select option b, in which the backlight operates at half power. If the option is selected, the device sets the drive level for the backlight to the ALD_MID level stored in the device. Alternatively, in order to provide an option whereby the option of being able to see the user interface is provided at the cost of power, option C is provided. Option D is an available option for each profile. If selected, this option turns the backlight off completely. For example, the user may usually use the device for browsing the internet. The Interactive option may then be selected to set the backlighting to be determined by the light detector (option a). However if the user is in a dimly lit place (e.g. the cinema), the user may wish to change the selection to option b so that the backlight is not turned on full when the device is used.

A further example of calibration will now be described with reference to Figure 25 9. This example calibrates for two ambient light settings at 1/3 and 2/3 of maximum backlight level.

1. Turn BACKLIGHT ENABLE on
2. Set $V_c=0V$
- 30 3. Measure either V1, V2 or backlight output

4. increase Vc until V1, V2 or backlight output falls to 2/3 of measurement in 3. Record Vc=Threshold 1
5. increase Vc further until V1, V2 or backlight output falls to 1/3 of measurement in 3. Record Vc=Threshold 2

5

The ambient light settings are selected by setting the Vc to the value recorded in 4 and 5 respectively. Setting Vc to step 01 turns the backlight on at a current determined by V_{be}/R_{sense} .

- 10 The present invention may be embodied in other specific forms without departing from its essential attributes. Accordingly reference should be made to the appended claims and other general statement's herein rather than to the foregoing specific description as indicating the scope of invention.
- 15 Furthermore, each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention independently of other disclosed and/or illustrated features. In this regard, the invention includes any novel features or combination of features disclosed herein either explicitly or any generalisation thereof irrespective of whether or not it relates to the claimed invention or mitigates any or all of the problems addressed.
- 20

The appended abstract as filed herewith is included in the specification by reference.

25

Claims

1. A portable device comprising:
 - a display;
 - 5 a light detector for detecting the light incident on at least part of the display;
 - a comparator for comparing the light detected with a given threshold;
 - and control means for controlling an illuminator for illuminating the display in dependence upon the output of the comparator, wherein the light detector is
 - 10 positioned to receive a light level that represents the total light contributing to display illumination which is the sum of the light received from the illuminator and the ambient light incident on the display.
2. A portable device according to claim 2 wherein the light detector is
15 located behind the display, remote from the surface of the display onto which the ambient light is incident.
3. A device as claimed in claim 1 or 2 wherein the control means disables
20 the illuminator in response to an indication by the comparator that the light detected exceeds a first threshold.
4. A device as claimed in claim 1 wherein the control means enables the illuminator in response to an indication by the comparator that the light detected is less than a second threshold.
- 25 5. A device as claimed in claim 4, when dependent upon claim 3, wherein the control means partially enables the illuminator in response to an indication by the comparator that the light detected is between the first and second thresholds.

6. A device as claimed in claim 1, further comprising means for determining a change in output of the light detector over a predetermined period, wherein the control means is arranged to disable functionality relating to the display in response to an indication that no change is determined.

5

7. A device as claimed in claim 6, wherein the control means is arranged to disable the display in response to an indication that no change is determined.

10 8. A device as claimed in claim 6 or 7, wherein the control means is arranged to disable the illuminator in response to an indication that no change is determined.

9. A device as claimed in claim 1, wherein the display comprises input
15 means responsive to a user.

10. A device as claimed in claim 9, wherein the control means controls the functionality relating to the display on the basis of settings input by the user via the input means.

20

11. A device as claimed in claim 9 or 10, wherein the input means comprises touch means, such as a key and/or display region.

12. A device as claimed in claim 1, which is a portable communications
25 device such as a radiotelephone.

13. A method of controlling a handportable device including a display and an illuminator for illuminating the display, the method comprising; detecting a light level that represents the total light contributing to display illumination
30 which is the sum of the light received from the illuminator and the ambient light incident on at least part of the display; comparing the light detected with

a given threshold; and controlling illumination of the display in dependence upon the output of the comparator.

14. A display module for an electronic device, the display module
5 comprising

a display panel having a front face to be viewed by a user and a reverse face,

an illuminator for illuminating the display panel,

10 a light detector being positioned adjacent the reverse face of the display panel to detect light, which light is the sum of ambient light incident on at least part of the display and the light from the illuminator,

a comparator for comparing the light detected with a given threshold, and

15 control means for controlling the illuminator in dependence on the output of the comparator.

15. A display comprising a display element, a light detector for detecting the light incident on at least part of a surface of a display element; a comparator for comparing the light detected with a given threshold; and
20 control means for controlling an illuminator for illuminating the display in dependence upon the output of the comparator, wherein the light detector is positioned to receive a light level that represents the total light contributing to illumination of the display which is the sum of the light received from the illuminator and the ambient light incident on the display.

Abstract**A portable device**

A handportable device is disclosed which comprises a user interface 1,
5 a light detector 21 for detecting the light incident on at least part of the user
interface, a comparator for comparing the light detected with a given
threshold and control means for controlling an illuminator for illuminating the
user interface in dependence upon the output of the comparator. Preferably
the light detector is positioned to detect light incident on the device, which
10 light is the sum of ambient light and the light from the illuminator.

Figure 8

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PAT 98032p*PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/04446	International filing date (day/month/year) 24/12/1999	Priority date (day/month/year) 31/12/1998
International Patent Classification (IPC) or national classification and IPC H04M1/22		
Applicant NOKIA MOBILE PHONES LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 7 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I Basis of the report
- II Priority
- III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV Lack of unity of invention
- V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI Certain documents cited
- VII Certain defects in the international application
- VIII Certain observations on the international application

Date of submission of the demand 01/05/2000	Date of completion of this report 14.03.2001
Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer  Golzio, D Telephone No. +31 70 340 3486

INTERNATIONAL PRELIMINARY
EXAMINATION REPORT

International application No. PCT/GB99/04446

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:

Description, pages:

1-18 as originally filed

Claims, No.:

1-21 as originally filed

Drawings, sheets:

1/10-10/10 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:

INTERNATIONAL PRELIMINARY
EXAMINATION REPORT

International application No. PCT/GB99/04446

the drawings, sheets:

5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

the entire international application.
 claims Nos. 17-19,21.

because:

the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

the description, claims or drawings (*indicate particular elements below*) or said claims Nos. see SECTION VIII are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet

the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination report cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

the written form has not been furnished or does not comply with the standard.

the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N) Yes: Claims

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/04446

No: Claims 1-16,20

Inventive step (IS) Yes: Claims
No: Claims 1-16,20

Industrial applicability (IA) Yes: Claims 1-16,20
No: Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

SECTION V

Claim 1

Using the wording of present Claim 1, document D1 (WO-A-9209163) discloses in figures 1 and 4 (the reference numerals noted being those of document D1), a portable device comprising: a user interface (30); a light detector for detector (54) for detecting the light incident on at least part of the user interface (30); a comparator (58) for comparing the light detected with a given threshold; and control means (58) for controlling an illuminator (53) for illuminating the user interface in dependance upon the output of the comparator.

The subject-matter of claim 1 is therefore novel (Article 33(2) PCT).

The same objection can be raised using the other documents listed in the International Search Report: D2, JP-A-10096890; D3, JP-A-7294877; D4, JP-A-60031393; D5, JP-A-10084408; D6, JP-A-9230827.

It should be noted that the objections against novelty have not been raised because of a broad formulation of the claims, it appears rather that above mentioned documents anticipate the portable device defined in the set of claims and described in the present Application.

Claims 2 to 15

The features defined in the dependent Claims 2 to 15 are either features well known in the art - cf. documents D1 to D6 - or design measures which one would regard as expected from the skilled person: the subject-matter of the resulting claims is either not novel (Art. 33(2) PCT) or novel but not inventive (Art. 33(3) PCT).

In particular D1 or D2 anticipate the feature of having a light detector receiving the sum of ambient light and the light from the illuminator as defined in Claim 2; D3 discloses the possibility of having multiple thresholds as defined in Claims 4 to 6; D4 discloses the possibility of determining a change in the output of the light detector over a predetermined period of time and, consequently, disabling a function of the device as defined in Claim 7.

Claim 16

Independent Claim 16 is the method equivalent of Claim 1: the objections raised against

Claim 1, equally apply to Claim 16.

Claim 20

Using the wording of present Claim 20, document D2 discloses in the sole figure (the reference numerals noted being those of document D2), a display module (1) for an electronic device, the display module comprising: a display panel (3) having a front face to be viewed by user and a reverse face, an illuminator (6) for illuminating the display panel; light detector (9) for detector for detecting the light incident on at least part of the display panel, the light detector being positioned adjacent the reverse face of the display panel to detect light incident on the device, which light is the sum of ambient light and the light from the illuminator; a comparator for comparing the light detected with a given threshold; and control means for controlling the illuminator dependance on the output of the comparator.

The subject-matter of claim 20 is therefore novel (Article 33(2) PCT).

It should be noted that a similar structure is proposed in document D1 wherein the light sensitive diode 54 positioned beneath the translucent elastomeric keypad 30, receives ambient light and light from the illuminator panel 53 (cf. D1, figure 4 and description page 5, line 8 to 29).

Moreover, the Applicant's attention is drawn to the disclosure of document D7 (EP-A-861017) which discloses the same structure of display/illuminator/light detector as depicted in figure 8 of the present application. D7 states (cf. figure 2) that the light leaking from the reflector sheet 13 is received by the light sensor 10. Even though the purpose of the device in D7 is to measure the light emitted by the illuminator, it cannot be deny that part of the ambient light is also received by the sensor 10.

SECTION VII

In the present case it is advisable the formulation of the claims in the two part form (Rule 6(3)(b) PCT), with those features which in combination are part of the prior art (see document D1) being placed in the preamble.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/04446

Documents D1-D7 should have been identified in the description and the relevant background art disclosed therein should have been briefly discussed (Rule 5(a)(ii) PCT).

Reference signs in parentheses should have been inserted in the claims to increase their intelligibility, Rule 6(2)(b) PCT. This applies to both the preamble and characterising portion.

The vague and imprecise statement in the description on page 17, line 24 to page 18, line 5, implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT) when used to interpret them (see also the PCT Guidelines, III-4.3a).

SECTION VIII

Claims 17, 18, 19 and 21 contain references to the description and/or the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here.

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

<p>To:</p> <p>HIBBERT, Juliet NOKIA IPR DEPARTMENT Nokia House Summit Avenue Farnborough Hampshire GU14 0NG GRANDE BRETAGNE</p>	<input type="checkbox"/> Comp Record <input type="checkbox"/> File Record <input type="checkbox"/> <input type="checkbox"/> D AF 16 MAR 2001 <input type="checkbox"/> Renewal Record <input type="checkbox"/> Citations <input type="checkbox"/> Inv Award	<p style="text-align: center;">PCT</p> <p style="text-align: center;">NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Rule 71.1)</p> <p><input type="checkbox"/> Letters Date of mailing (day/month/year) 14.03.2001</p>
<p>Applicant's or agent's file reference PAT 98032p*PCT</p>		IMPORTANT NOTIFICATION
International application No. PCT/GB99/04446	International filing date (day/month/year) 24/12/1999	Priority date (day/month/year) 31/12/1998
<p>Applicant NOKIA MOBILE PHONES LIMITED et al.</p>		

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

<p>Name and mailing address of the IPEA/</p> <p>European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016</p>	<p>Authorized officer</p> <p>Smits, A</p> <p>Tel. +31 70 340-3596</p>
--	---



PATENT COOPERATION TREATY
PCT
INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PAT 98032p*PCT	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB99/04446	International filing date (day/month/year) 24/12/1999	Priority date (day/month/year) 31/12/1998	
International Patent Classification (IPC) or national classification and IPC H04M1/22			
Applicant NOKIA MOBILE PHONES LIMITED et al.			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I Basis of the report
- II Priority
- III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV Lack of unity of invention
- V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI Certain documents cited
- VII Certain defects in the international application
- VIII Certain observations on the international application

Date of submission of the demand 01/05/2000	Date of completion of this report 14.03.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer Golzio, D Telephone No. +31 70 340 3486



INTERNATIONAL PRELIMINARY
EXAMINATION REPORT

International application No. PCT/GB99/04446

the drawings, sheets:

5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

the entire international application.
 claims Nos. 17-19,21.

because:

the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

the description, claims or drawings (*indicate particular elements below*) or said claims Nos. see SECTION VIII are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet

the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination report cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

the written form has not been furnished or does not comply with the standard.
 the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N) Yes: Claims

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/04446

No: Claims 1-16,20

Inventive step (IS) Yes: Claims
No: Claims 1-16,20

Industrial applicability (IA) Yes: Claims 1-16,20
No: Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/04446

SECTION V

Claim 1

Using the wording of present Claim 1, document D1 (WO-A-9209163) discloses in figures 1 and 4 (the reference numerals noted being those of document D1), a portable device comprising: a user interface (30); a light detector for detector (54) for detecting the light incident on at least part of the user interface (30); a comparator (58) for comparing the light detected with a given threshold; and control means (58) for controlling an illuminator (53) for illuminating the user interface in dependence upon the output of the comparator.

The subject-matter of claim 1 is therefore novel (Article 33(2) PCT).

The same objection can be raised using the other documents listed in the International Search Report: D2, JP-A-10096890; D3, JP-A-7294877; D4, JP-A-60031393; D5, JP-A-10084408; D6, JP-A-9230827.

It should be noted that the objections against novelty have not been raised because of a broad formulation of the claims, it appears rather that above mentioned documents anticipate the portable device defined in the set of claims and described in the present Application.

Claims 2 to 15

The features defined in the dependent Claims 2 to 15 are either features well known in the art - cf. documents D1 to D6 - or design measures which one would regard as expected from the skilled person: the subject-matter of the resulting claims is either not novel (Art. 33(2) PCT) or novel but not inventive (Art. 33(3) PCT).

In particular D1 or D2 anticipate the feature of having a light detector receiving the sum of ambient light and the light from the illuminator as defined in Claim 2; D3 discloses the possibility of having multiple thresholds as defined in Claims 4 to 6; D4 discloses the possibility of determining a change in the output of the light detector over a predetermined period of time and, consequently, disabling a function of the device as defined in Claim 7.

Claim 16

Independent Claim 16 is the method equivalent of Claim 1: the objections raised against

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/04446

Claim 1, equally apply to Claim 16.

Claim 20

Using the wording of present Claim 20, document D2 discloses in the sole figure (the reference numerals noted being those of document D2), a display module (1) for an electronic device, the display module comprising: a display panel (3) having a front face to be viewed by user and a reverse face, an illuminator (6) for illuminating the display panel; light detector (9) for detector for detecting the light incident on at least part of the display panel, the light detector being positioned adjacent the reverse face of the display panel to detect light incident on the device, which light is the sum of ambient light and the light from the illuminator; a comparator for comparing the light detected with a given threshold; and control means for controlling the illuminator dependance on the output of the comparator.

The subject-matter of claim 20 is therefore novel (Article 33(2) PCT).

It should be noted that a similar structure is proposed in document D1 wherein the light sensitive diode 54 positioned beneath the translucent elastomeric keypad 30, receives ambient light and light from the illuminator panel 53 (cf. D1, figure 4 and description page 5, line 8 to 29).

Moreover, the Applicant's attention is drawn to the disclosure of document D7 (EP-A-861017) which discloses the same structure of display/illuminator/light detector as depicted in figure 8 of the present application. D7 states (cf. figure 2) that the light leaking from the reflector sheet 13 is received by the light sensor 10. Even though the purpose of the device in D7 is to measure the light emitted by the illuminator, it cannot be deny that part of the ambient light is also received by the sensor 10.

SECTION VII

In the present case it is advisable the formulation of the claims in the two part form (Rule 6(3)(b) PCT), with those features which in combination are part of the prior art (see document D1) being placed in the preamble.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/04446

Documents D1-D7 should have been identified in the description and the relevant background art disclosed therein should have been briefly discussed (Rule 5(a)(ii) PCT).

Reference signs in parentheses should have been inserted in the claims to increase their intelligibility, Rule 6(2)(b) PCT. This applies to both the preamble and characterising portion.

The vague and imprecise statement in the description on page 17, line 24 to page 18, line 5, implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT) when used to interpret them (see also the PCT Guidelines, III-4.3a).

SECTION VIII

Claims 17, 18, 19 and 21 contain references to the description and/or the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here.

Claims

1. A portable device comprising:
 - a display;
- 5 a light detector for detecting the light incident on at least part of the display;
 - a comparator for comparing the light detected with a given threshold; and control means for controlling an illuminator for illuminating the display in dependence upon the output of the comparator, wherein the light detector is
- 10 positioned to receive a light level that represents the total light contributing to display illumination which is the sum of the light received from the illuminator and the ambient light incident on the display.
2. A portable device according to claim 2 wherein the light detector is located behind the display, remote from the surface of the display onto which the ambient light is incident.
- 15 3. A device as claimed in claim 1 or 2 wherein the control means disables the illuminator in response to an indication by the comparator that the light detected exceeds a first threshold.
- 20 4. A device as claimed in claim 1 wherein the control means enables the illuminator in response to an indication by the comparator that the light detected is less than a second threshold.
- 25 5. A device as claimed in claim 4, when dependent upon claim 3, wherein the control means partially enables the illuminator in response to an indication by the comparator that the light detected is between the first and second thresholds.
- 30 6. A device as claimed in claim 1, further comprising means for determining a change in output of the light detector over a predetermined

period, wherein the control means is arranged to disable functionality relating to the display in response to an indication that no change is determined.

7. A device as claimed in claim 6, wherein the control means is arranged 5 to disable the display in response to an indication that no change is determined.

8. A device as claimed in claim 6 or 7, wherein the control means is arranged to disable the illuminator in response to an indication that no change 10 is determined.

9. A device as claimed in claim 1, wherein the display comprises input means responsive to a user.

15 10. A device as claimed in claim 9, wherein the control means controls the functionality relating to the display on the basis of settings input by the user via the input means.

11. A device as claimed in claim 9 or 10, wherein the input means 20 comprises touch means, such as a key and/or display region.

12. A device as claimed in claim 1, which is a portable communications device such as a radiotelephone.

25 13. A method of controlling a handportable device including a display and an illuminator for illuminating the display, the method comprising; detecting a light level that represents the total light contributing to display illumination which is the sum of the light received from the illuminator and the ambient light incident on at least part of the display; comparing the light detected with 30 a given threshold; and controlling illumination of the display in dependence upon the output of the comparator.

14. A display module for an electronic device, the display module comprising

a display panel having a front face to be viewed by a user and a reverse face,

5 an illuminator for illuminating the display panel,

a light detector being positioned adjacent the reverse face of the display panel to detect light, which light is the sum of ambient light incident on at least part of the display and the light from the illuminator,

a comparator for comparing the light detected with a given threshold,

10 and

control means for controlling the illuminator in dependence on the output of the comparator.

15. A display comprising a display element, a light detector for detecting

the light incident on at least part of a surface of a display element; a comparator for comparing the light detected with a given threshold; and

control means for controlling an illuminator for illuminating the display in dependence upon the output of the comparator, wherein the light detector is positioned to receive a light level that represents the total light contributing to

20 illumination of the display which is the sum of the light received from the illuminator and the ambient light incident on the display.